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THESIS

EXECUTIVE MANAGEMENT EDUCATION TRACKING SYSTEM (EMETRAK) DESIGN AND IMPLEMENTATION ISSUES

by

Steven M. Jones

June 1996

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Form Approved OMB No. 0704-0188

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1. AGENCY USE ONLY (Leave blank)	2. REPORT DATE June 1996	3. REPORT TYPE AND DATES COVERED Master's Thesis	
4. TITLE AND SUBTITLE EXECUTIVE MANAGEMENT EDUCATION TRACKING SYSTEM (EMETRAK) DESIGN AND IMPLEMENTATION ISSUES		5. FUNDING NUMBERS	
6. AUTHOR(S) Jones, Steven M.			
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Postgraduate School Monterey CA 93943-5000		8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES) Institute for Defense Education and Analysis, Naval Postgraduate School Monterey CA 93943-5000		10. SPONSORING/MONITORING AGENCY REPORT NUMBER	
11. SUPPLEMENTARY NOTES The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.			
12a. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution is unlimited.		12b. DISTRIBUTION CODE	
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14. SUBJECT TERMS Systems Analysis and Design, Database design, Client-server			15. NUMBER OF PAGES 173
			16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT UL

NSN 7540-01-280-5500

Standard

Form 298 (Rev. 2-89)

Prescribed by ANSI Std. Z39-18 298-102

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**EXECUTIVE MANAGEMENT EDUCATION TRACKING SYSTEM
(EMETRAK) DESIGN AND IMPLEMENTATION ISSUES**

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Submitted in partial fulfillment
of the requirements for the degree of

**MASTER OF SCIENCE IN INFORMATION TECHNOLOGY
MANAGEMENT**

from the

**NAVAL POSTGRADUATE SCHOOL
June 1996**

Thesis
J72914
C.2

ABSTRACT

The Executive Management Education Program is the Department of the Navy's competency-based educational program for senior health care executives. It is designed to prepare Navy Medical Department officers for the challenges of managing modern military health care programs. This research effort analyzes the requirements of an information system to support the Executive Management Education Program. The systems development life cycle is used as a project management tool to guide system development. A requirements study is conducted to determine the information needs of the various customers. Process, data, and network models are used to describe system requirements. A prototype single-user system is implemented using Microsoft Access 2.0 and an architecture for a multi-user client server database application is proposed.

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I. INTRODUCTION

A. BACKGROUND

The United States Congress mandated in the 1992 Department of Defense (DOD) Appropriation Act that:

“None of the funds appropriated in this Act may be used to fill the Commander’s position at any military medical facility with a health care professional unless the prospective candidate can demonstrate professional administrative skills.” [Ref. 1]

In response to this mandate, the Deputy Surgeon General of the Navy established a partnership between the Bureau of Medicine and Surgery (BUMED) and the Naval Postgraduate School (NPS) to develop a comprehensive competency-based educational program for the U. S. Navy’s senior health care executives. This initiative has taken the form of the Executive Management Education (EME) Program.

1. What is EME?

The EME Program is an executive medical education curriculum consisting of 49 course modules and 410 hours of instruction. The syllabus was developed over an 18 month period by subject matter experts at NPS after a careful analysis of the core competencies required in the field of health care administration. [Ref. 2] To date, DOD has defined 44 administrative competencies across nine competency categories that pertain specifically to health care administration. The BUMED/NPS team started with these competencies and completed a detailed needs assessment to identify those skills which the Navy’s senior medical officers felt were most important to effectively manage a military medical treatment facility (MTF). The current EME Program curriculum was built around the findings of that needs assessment. The curriculum, however, is not static and future expansion to meet the remaining DOD defined competencies is underway --

particularly in regard to changing business practices associated with DOD health care reform initiatives (TRICARE).

The objective, then, of the EME Program is to educate senior military health care executives to achieve those specifically defined administrative skills and competencies that have been determined a prerequisite for command of major DOD MTFs or other complex health care delivery systems.

Implementation of the EME curriculum is as follows. Teams of NPS faculty members travel to MTFs around the world to provide blocks of instruction covering the various competency categories. Because it is fiscally and operationally impractical to educate all of the Navy's prospective health care leaders in one central location, these presentation teams spend a considerable amount of time "on the road" teaching course modules so that the disruption to MTF day to day operations is minimized. While on-site delivery of course modules by NPS faculty is the current pedagogy, the future use of a distributed educational system such as videotele-education (VTE) and videoteleconferencing (VTC) is a viable alternative format for some of the course modules.

2. Why EMETRAK?

As the program matures, many offices within the Department of the Navy will be interested in the EME program enrollment status of selected officers. These entities will range from Medical Department specialty advisors, detailers, and promotion boards to the Corps chiefs as they assess an officer's specific administrative skills and qualifications preliminary to assignment or promotion decisions. Progress towards completion of the EME program will, in the future, be viewed as a commitment to attaining the necessary competencies required for command of a Navy MTF. For this very reason, an accurate and up-to-date record of EME course completion is critical. Moreover, due to the comprehensive nature of the EME program, it may take several years for an officer to complete the entire curriculum. Therefore, officers will move to new duty stations and

serve in many different billets while enrolled in the program. In spite of the officer career dynamics, the Navy will require that an accurate cumulative record of attained competencies be maintained. This concept is the basis for the Executive Management Education Tracking (EMETRAK) system.

The EME program manager located at the Naval School of Health Sciences (NSHS) in Bethesda, MD and the EME program coordinator at NPS have indicated that an information system supporting the EME Program should have the following characteristics:

- Provide a consolidated record of all eligible Navy medical department officers (Medical, Medical Service, Nurse and Dental Corps), their billet and command information, and the specifics of each course taken within the EME program.
- Officer demographics data in the system must be capable of being updated by the officer's command or through information provided directly by the Bureau of Naval Personnel (BUPERS).
- EME course completion data should input at the officer's command, a third-party training site, by the EME program coordinator's staff at NPS, or by the EME program manager's staff at the NSHS.
- A "robust" query and reporting capability on the officers enrolled in the EME program.
- The officer's integrated educational record must be made available to all personnel agencies providing career mentoring to medical department officers or making decisions about officer career planning.
- A future expansion capability to enable remote access and viewing of officer records by responsible agencies.

The characteristics described in this section serve as a starting point for further study of system requirements.

B. PURPOSE OF RESEARCH

The purpose of this research is to conduct a thorough study of the information requirements for a system that supports the EME program and to recommend an implementation plan that adequately satisfies those needs.

C. METHOD

The Systems Development Life Cycle (SDLC) provides a logical methodology for developing and maintaining an information technology (IT) solution. The SDLC is a project management tool used to plan, execute, and control an IT systems development project. SDLC consists of five phases: Systems Analysis, Systems Definition, Systems Design, Systems Implementation, and Systems Support. [Ref. 3] The cycle begins with the Systems Analysis phase in which a business problem and an information architecture to solve the business problem are defined. During the next phase, Systems Definition, the user requirements are closely analyzed and a logical design for information flow and data modeling are proposed. Systems Design, the third phase, involves the evaluation of alternative solutions and the physical design of an information system. The fourth step is the Systems Implementation phase which encompasses the construction and testing of the production system. The final phase, Systems Support, involves ongoing maintenance and recommendations for system improvement. The SDLC will be used as a guide for the development of an information system to support the business needs of the EME program.

D. SCOPE OF RESEARCH

The study will focus on the following research questions in its examination of possible solutions for EMETRAK:

1. Who are the EMETRAK system owners and users and what are their information requirements?
2. What type of information system will support the future needs of the EME program?
 - a. A single-user personal computer (PC) based database application?
 - b. A multi-user database architecture implemented over a local area network?
 - c. A multi-user database architecture implemented over a wide area network?
3. What system processes are necessary to track the administrative educational records of all EME eligible Navy Medical Department officers?
4. Once a computer solution is selected, what features of contemporary database management system applications are desired for the EMETRAK system?
5. What are the design issues for the candidate system?
 - a. What will the conceptual data model look like?
 - b. What will the process model look like?
 - c. How will data be updated?
 - d. What type of architecture will support the process and data models?
 - e. What are the data and system security issues?
 - f. What are the system inputs and outputs?
 - g. What type of queries are required?
 - h. Will the database architecture be scaleable and support future growth?

This study will involve a detailed examination of the feasibility, costs, benefits, process and data requirements of developing an operational database management system. Requirement specifications for a prototype database application will also be developed. The end product will be a prototype database application developed from the requirement specifications using the Microsoft Access 2.0® relational database application. The study concludes with recommendations for implementing a remotely accessed multi-user database application.

E. THESIS ORGANIZATION

The thesis is organized into seven chapters and eleven appendices. Chapter II discusses the Systems Analysis phase and includes an initial feasibility study of the proposed system. Chapters III, IV, and V address definition, design and implementation issues, respectively, for the prototype system (Phase I). Chapter VI discusses analysis and definition issues for a multi-user system (Phase II). Lessons learned during each phase of the SDLC are included in the appropriate chapters. Conclusions and recommendations are provided in Chapter VII. Existing system network topologies, process models, prototype queries, and reports are included as appendices to the study.

II. SYSTEMS ANALYSIS PHASE

A. METHOD

The Systems Analysis phase began with an initial investigation of the business environment. The EME program manager, EME program coordinator, and selected NPS Systems Management faculty were interviewed to determine the project scope and system boundaries. A questionnaire (Appendix A) was the primary tool used during the initial interviews to help define the problem and gain an understanding of the people, data, activity, and networking requirements of the proposed system. NPS staff studies and EME program documentation were consulted to provide insight into the history and goals of the executive education program. The EME course catalog provided curriculum information and described the competency categories. A problem statement and system requirements were developed from the information gathered during the initial investigation.

B. PROBLEM STATEMENT

The EMETRAK system is to provide an integrated educational record on all Navy medical department officers in the grade of 0-3 (LT) and above enrolled in the EME curriculum. This entails tracking approximately 11,300 officers located in 13 Health Service Regions (HSR) around the world (Figure 1) and officers assigned to operational units (ships, deployed units, etc.). The record must be made available to the officer and those personnel agencies responsible for providing officer career planning decisions (BUMED, BUPERS). The system must be flexible enough to handle a highly transient population and different course modules from a variety of executive education sources outside of the EME curriculum. The long-term requirement for the system is for distributed access to officer information from various sites including all major Navy

medical treatment facilities (MTF), regional training sites, curriculum sponsors, BUMED, BUPERS, and the EME Program staff for a total of 71 end-user sites. Table 1 shows the number of anticipated end-user sites for a distributed system and Appendix B contains a detailed listing of the MTFs which would have EMETRAK terminals.

Agency	Number
Medical Treatment Facilities	55
BUMED	5
BUPERS	3
NSHS, Bethesda, MD	3
NPS	5
Total	71

Table 1. Proposed Number of End-user Sites

C. SCOPE

The proposed information system will collect, maintain, collate, and report all information required by the EME program. This includes information gathered by the program manager at the Naval School of Health Sciences (NSHS) in Bethesda, MD, the program coordinator at NPS, individual commands, BUPERS, BUMED, and other external training sources granting continuing education unit (CEU) credits. The scope of the EMETRAK system will be limited to the business functions of the EME program and, consequently, no effort is foreseen to consolidate the tracking requirements of other professional medical education programs. However, the backbone of this system could suggest additional future applications.

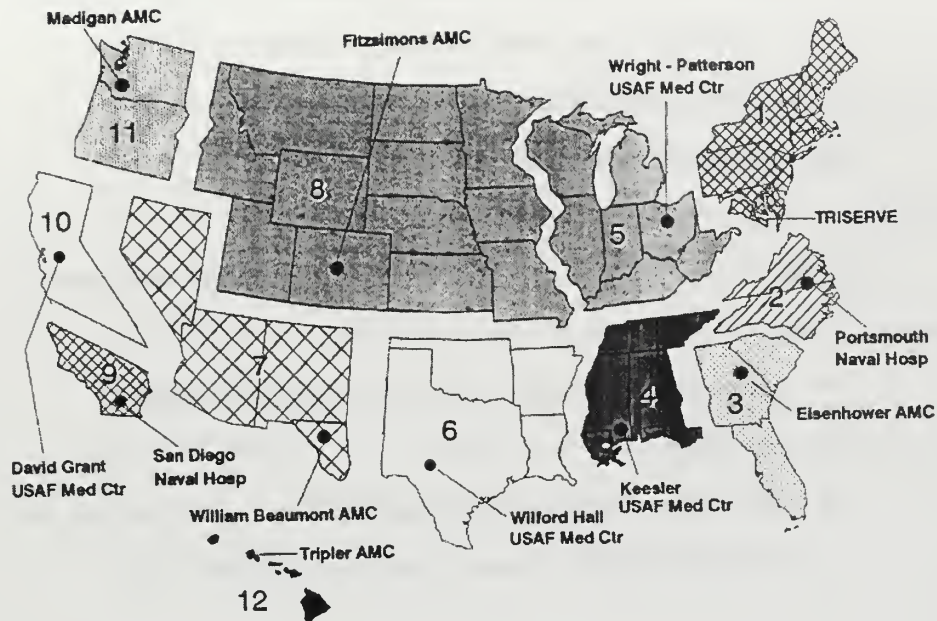


Figure 1. DOD Health Service Regions [After Ref. 4, p. 8]

Note: HSR 13 refers to overseas commands

1. System Owner and Users

a. System Owner

The initial project management responsibilities for the development of the proposed information system has been assigned to the EME program coordinator at NPS by the EME program manager at NSHS, Bethesda. The program coordinator is considered to be the EMETRAK system owner for the purpose of this study.

b. System Users

The information system will directly affect the following users:

- EME program manager and the staff at NSHS, Bethesda, MD.
- EME program support staff at NPS

- Staff Education and Training Departments of Navy MTFs
- Personnel Departments of Navy MTFs
- BUMED Planning and Programming Divisions
- Medical Department Specialty Advisors

The information system will indirectly affect the following users:

- Medical Department Corps Chiefs and their offices
- BUPERS
- All Navy medical department officers (O-3 and above) in the Medical, Medical Service, Nurse, and Dental Corps

2. Context Diagram

A context diagram defines the boundary of a system-in-focus, identifies its key external entities, and the interaction between the two. [Ref. 5, p. 221] The EMETRAK context diagram (Figure 2) depicts BUMED, BUPERS, the MTFs, the Corps chiefs, NSHS, and the EME program staff as external entities to the internal functionality of the EMETRAK system-in-focus. The diagram also illustrates the anticipated interactions, in terms of inputs and outputs, between the external entities and the EMETRAK system.

3. Internal Entities

Internal entities are objects within a closed system about which the system owner desires to collect data. Within EMETRAK, there are five major entities: OFFICER, UIC, CLASS, COURSE, and COMPETENCY.

- **OFFICER** - OFFICER refers to any medical department officer (grade 0-3 and above) with the designator of 2100 (Medical Corps), 2200 (Dental

Corps), 2300 (Medical Service Corps), or 2900 (Nurse Corps) enrolled in the EME program.

- **UIC** - UIC refers to the unit identification code which is a unique numerical designation for a DOD medical treatment facility.
- **CLASS** - A CLASS is an instance of an EME eligible officer taking a course module.
- **COURSE** - A COURSE is one of the course modules designated in the EME curriculum.
- **COMPETENCY** - COMPETENCY refers to a competency category specified in the EME course catalog.

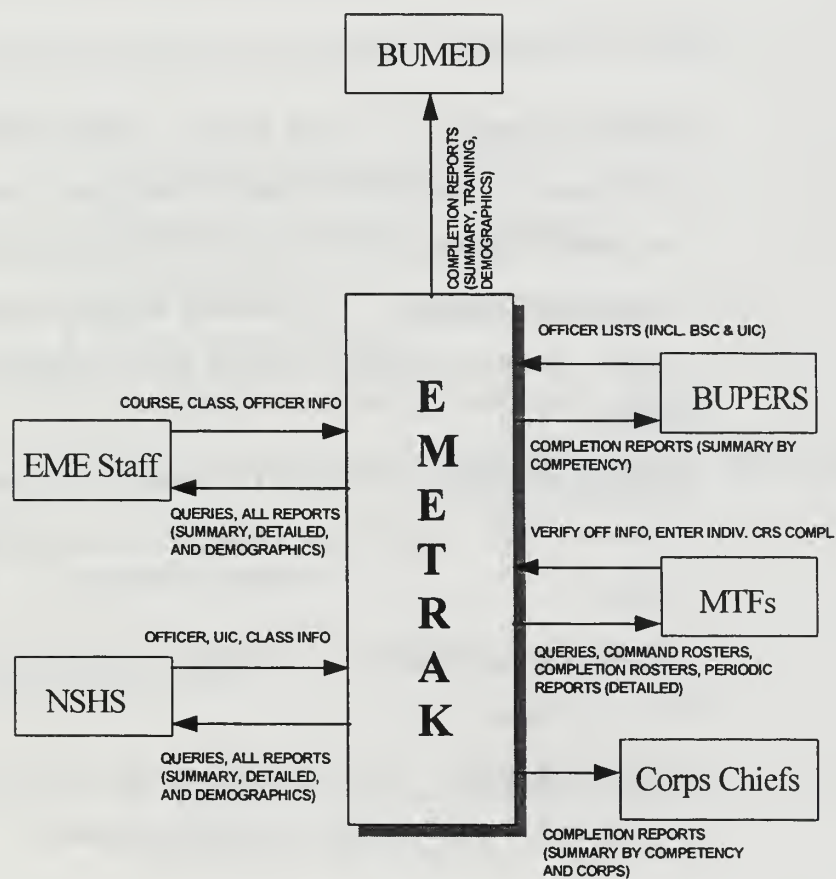


Figure 2. EMETRAK Context Diagram

D. INFORMATION SYSTEM FUNCTIONS

1. Desired Functions

- Ability to add, delete, modify, display, and automatically update related fields
- Ability to search and query the database for records based on a variety of selection criteria
- Ability to print screens and reports as desired by the users to satisfy local, higher echelon, and other on-demand requirements
- Ability to print officer transcripts and completion certificates

2. Data To Be Tracked

- Officer Information - Social Security Number (SSN), name, rank, billet sequence code (BSC) number, designator, job title, command unit identification number (UIC) and electronic mail address
- Command Information - UIC number, address, commercial telephone number, Defense Switched Network (DSN) telephone number, HSR number
- Course Information - Course ID number, course name, course length in hours, CEU credit hours, competency classification, and course sponsor
- Competency Information - Competency title and course assigned to that competency
- Class Information - SSN of the officer, course ID number, class date, class location, class instructor, and host command

3. Queries To Be Generated

System queries are divided into three major categories: structured, interactive, and statistical queries. Structured queries are standardized pre-coded queries which require no user input other than selecting the actual query. Structured queries should focus on providing a browse function for the data in different representations. Interactive queries should be more flexible and provide a narrower cross-sectional view of the data based upon the criteria input by the user. Statistical queries should be designed to provide statistical and demographic summaries of the database for the purposes of program management rather than for viewing data.

a. Structured Queries

Structured queries should include:

- All officers in alphabetical order
- All officers sub-divided by command
- List of all UICs
- List of all EME courses
- List of all course titles by competency category
- List of all course modules provided in the last 30/60/90 days

b. Interactive Queries

These should include:

- All officers and course modules competed in a specified command (user inputs UIC)
- List of all officers satisfying a specific profile (user inputs one or all of: rank, HSR, competency, designator)

- List of course modules and hours completed by a specific officer (user inputs SSN)

c. Statistical Queries

Statistical queries should include:

- The number of officers that have attained each competency
- The number of students within each HSR enrolled in EME
- The percentage of officers that have completed each competency category within each UIC
- The percentage of officers that have completed each competency category, sub-divided by rank
- The number of officers that have completed each competency category

4. Reports To Be Generated

EMETRAK must be capable of generating reports based upon the structured and interactive queries that have been mentioned in the previous section. The reports desired by the system owner include the following:

- Alphabetical roster of all enrolled officers and the course modules that they have completed
- Alphabetical roster of officers, sub-divided by command, and the course modules that each has completed
- Mailing list of all participating commands
- List of all EME course modules by competency category
- Course completion letters

- Course completion certificates
- Officer transcripts

E. PROJECT PHASES

The proposed system is straight-forward in its business rules, logical architecture, input/output and report generation requirements. What sets it apart is the system owner's desire to implement a low cost interactive system distributed over a wide area. Further, the system owner desires an initial data storage, information retrieval, and reporting capability within 60 days of project commencement because of the frequency with which courses will be delivered during the last quarter of FY-95. These requirements lend themselves to a two-phased approach for system development. Phase I is envisioned as a single-user personal computer (PC) based database application developed using a fourth generation language (4GL) and rapid prototyping techniques. Phase II migrates all functionality of the single-user system to a widely distributed multi-user environment using the existing Navy Medical Department Network (NMDN) as a backbone.

F. FEASIBILITY

The feasibility analysis is a cross life cycle activity that must be continuously performed throughout the systems development process. [Ref. 5, p. 812] The initial assessment is performed to measure the urgency of the problem and determine if further detailed study of the problem is warranted. A more detailed study of the problem, its opportunities, and constraints is completed during the Systems Analysis phase of the SDLC and will be discussed in the next chapter. The feasibility analysis is guided by the following tests: political, operational, economic, technical, and schedule feasibility.

1. Political Feasibility

It is clear from the congressional mandate that today's taxpayer has the same expectation of health care administration in the Defense Department, with respect to quality and cost containment, as they do of the private sector. These expectations lead to a new era in which DOD must better prepare its medical leadership for the future challenges of health care management. This new climate of educating the prospective commanders in specific health care related administrative skills and competencies formalizes what has, in the past, been an informal process left to the individual medical department officer. As with any change effort, the idea of having a formal requirement for executive education will undoubtedly meet some initial resistance. However, since the Surgeon General of the Navy has given strong support to the EME concept and there are strong budgetary implications associated with the successful implementation of such a program, Navy-wide acceptance is all but assured. Language in the DOD Authorization Act for FY-96 further directs executive education activities in support of TRICARE program implementation - both for Lead Agent commanders and their HSR MTF support personnel. [Refs. 6, 7]

The EME program management staff views the current climate as an opportunity to provide quality, cost effective executive education not only to those prospective MTF commanders, but also to the larger population of medical officers thereby increasing the overall competency of the Navy's medical professionals. An effective information system, with the capabilities envisioned for EMETRAK, that captures the accomplishments of program participants and directly involves them in their educational process will accelerate initial acceptance of the EME program within the Navy's medical community.

2. Operational Feasibility

Operational feasibility is a measure of how well a solution to a problem will work in an organization. This section examines the anticipated level of acceptance of an automated solution for the EME program.

The program manager anticipates that during the final quarter of FY-95 65 hours of formal instruction will be provided and 270 officers will be enrolled in the program. That number is expected to triple during FY-96 and will steadily increase over the next several years. Clearly, automating the process of recording instances of EME instruction, producing program reports, and officer transcripts is justified given the anticipated frequency of course delivery and volume of data in the future.

Implementation of any new information system presents operational challenges. While the routine recording of basic officer information, course modules, and class rosters at the EME program office will offer no serious challenges, the periodic import of officer personnel information from the BUPERS database, the regular distribution of program information to the various customer sites, and remote access to the database over a wide area network (WAN) by those customer sites is a bit more difficult. For these reasons, separating the functional design of Phase I from the challenges of remote access in Phase II are necessary.

a. Data Import

The officers who participate in the EME program are highly transient. They can expect to move to a new duty station a minimum of every three years. Therefore, the officer data file in the EMETRAK database will require frequent updating in order to maintain data accuracy. In order to accomplish this requirement, the Officer Master file from BUPERS could be used as a source to update EMETRAK officer information. The frequency of update is anticipated to be a monthly requirement and an agreement between the EME program staff and BUPERS for the recurring download of medical department officer data is being coordinated.

b. Remote Access

Navy Medicine maintains a three-tiered hierarchical network infrastructure known as the Navy Medical Department Network (NMDN). The NMDN is composed of a wide area network (WAN), a series of metropolitan area networks (MAN) and local area networks (LAN). The WAN uses the existing Defense Information Systems Network (DISN), formerly known as the Defense Data Network (DDN), a packet switched network conforming to the Consultative Committee for International Telegraphy and Telephony (CCITT) X.25 protocol to provide connectivity between each MAN. The MANs are centered around major regional medical installations. Within each MAN are interconnected Ethernet local area networks (LANs) which conform to IEEE 802.3 standards and support local MTF operations. Remote access to EME program information is feasible in Phase I through plain old telephone service (POTS), facsimile, electronic mail, electronic file transfer, and World Wide Web (WWW) access. A study of the existing NMDN topologies reveals that in a Phase II implementation the remote access options to EMETRAK data include: dial-in access using a modem, WWW applications, and the use of client-server applications over DISN.

c. User Acceptance

Observation of the EME Management Group during their normal office routine reveals that they are intelligent and literate personal computer users. They are familiar with the Windows® operating environment and Windows-compatible applications. The selection of a commercial-off-the-shelf (COTS) Windows-compatible database application seems a preferable solution for Phase I because of the familiarity of the EME support staff with the Windows® graphical user interface and its functionality. Familiarity with the application environment and confidence in its interoperability with other EME program office applications will enhance end-user acceptance of any software solution provided as part of Phase I.

The hope for Phase II is to migrate the functionality of the Phase I single-user application to a multi-user environment with an EMETRAK application interface residing at each MTF and other sites exercising managerial responsibility for the program. Acceptance of an EMETRAK application by this larger end-user population will require that the application be compatible with other MTF software applications, have a familiar graphical user interface, and have acceptable response time over the network. A survey of Navy MTF office automation products shows that the Windows® version of Microsoft Office Professional 4.3 is the office automation standard. This integrated package provides Microsoft Word 6.0® for word processing, Excel 5.0® for spread sheet functions, Powerpoint 4.0® for presentations, and Access 2.0® for database functions. A Windows® application which is compatible with the current integrated suite standard or uses one of its resident applications will certainly enhance acceptance of the Phase II product.

3. Economic Feasibility

A separate cost-benefit analysis was completed to measure the cost effectiveness of the project and portions of that analysis are provided in this section to show the relative merits of the proposed options. [Ref. 8]

a. Costs

The options considered were 1) a completely manual system, 2) a single user database management system (DBMS) with manual input/output/information exchange which represents Phase I functionality, and 3) a multi-user DBMS with distributed access via the Internet which represents Phase II functionality. The analysis began by identifying the tasks required to successfully implement a manual record-keeping and tracking system for the program. These tasks were measured in person-hours and the manual system was then used as a baseline from which to compare the

relative costs of two automated solutions. Standard government wage rates provided by the NPS Human Resource Office and adjusted by the requirements of the Navy Comptroller's manual were used for calculating personnel costs for each alternative. The cost of each alternative was sub-divided into non-recurring costs which considered activation or start-up costs and recurring or operating costs. The total cost of each alternative was then discounted at the government standard rate of ten percent for a period of seven years to achieve a present value figure which could be compared.

Project size, development time, and average staff size requirements for the development of the applications in Alternatives two and three were estimated using Function Point analysis and the Constructive Cost Model (COCOMO) in the organic and semi-detached modes, respectively. According to the models, the single user system (Alternative 2 - Phase I) was a 2100 lines of code project which could be developed in 5.23 person-months with an average staff size of 1.33 persons. The models estimated that the multi-user system (Alternative 3 - Phase II), a slightly more complex project with over 3130 lines of code, could be completed with an average staff size of 1.88 persons in 5.75 months. These figures were the basis for the non-recurring project development cost calculations after standard wage rates were applied.

Tables 2 through 4 summarize the present value costs of the three alternatives discussed in the cost-benefit analysis. The cash flow figures in the tables include both non-recurring and recurring costs. From the tables it is apparent that the manual system (Alternative 1) is the most expensive option in terms of present value. The reason for this higher figure is the increased annual operating cost incurred because the manually intensive system requires more person-hours to maintain a given set of records than do the other two options.

The single user system (Table 3) reflects a higher initial investment in Year 0 than does Alternative 1 because this option requires hardware and software, but the annual operating costs as a result of implementing the system are projected to be significantly less than the manual system.

Year	0	1	2	3	4	5	6	7
Cash Flow	\$ 32,301	\$ 130,248	\$ 130,248	\$ 130,248	\$ 130,248	\$ 130,248	\$ 130,248	\$ 130,248
PV Factor	1.0	0.909	0.826	0.751	0.683	0.621	0.564	0.513
Present Value	\$ 32,301	\$ 118,407	\$ 107,642	\$ 97,857	\$ 88,961	\$ 80,873	\$ 73,521	\$ 66,837
Total PV	\$ 666,400							

Table 2. Present Value of Alternative 1 Costs

Year	0	1	2	3	4	5	6	7
Cash Flow	\$ 71,702	\$ 67,074	\$ 67,074	\$ 67,074	\$ 67,074	\$ 67,074	\$ 67,074	\$ 67,074
PV Factor	1.0	0.909	0.826	0.751	0.683	0.621	0.564	0.513
Present Value	\$ 71,702	\$ 60,976	\$ 55,433	\$ 50,393	\$ 45,812	\$ 41,647	\$ 37,861	\$ 34,419
Total PV	\$ 398,242							

Table 3. Present Value of Alternative 2 Costs

Alternative 3 requires an even higher initial investment than does Alternative 2 because of higher development costs and increased complexity with respect to operating system, application software, and hardware requirements. The annual operating costs are also anticipated to be higher than Alternative 2, however, they are still much less than Alternative 1.

Year	0	1	2	3	4	5	6	7
Cash Flow	\$ 157,660	\$ 80,238	\$ 80,238	\$ 80,238	\$ 80,238	\$ 80,238	\$ 80,238	\$ 80,238
PV Factor	1.0	0.909	0.826	0.751	0.683	0.621	0.564	0.513
Present Value	\$ 157,660	\$ 72,943	\$ 66,312	\$ 60,284	\$ 54,803	\$ 49,821	\$ 45,292	\$ 41,174
Total PV	\$ 548,288							

Table 4. Present Value of Alternative 3 Costs

b. Benefits

It has been assumed that all three alternatives will accomplish the mandated requirements of EME. The tangible benefits of each alternative are achieved by performing the same job at a lower net present cost than the other competing alternatives. A number of intangible benefits can be identified that are independent of the direct requirement. The value of these “intangibles” should be weighed by the system owner in addition to the strict bottom line cost.

Both the single-user and multi-user systems offer increased manageability of data to the EME program staff because electronic files are easier to maintain, duplicate, and transfer than paper ones. Further, both systems offer an adaptable query and reporting capability which is not available in a manual system. There is intangible value in the speed of information processing and reduced wait time for the customer provided by these options. Finally, through automation, the EME program would realize increased data accuracy and ease of verification by using exception reports, traditional automated database functions, and by involving the officer more closely with their educational record (Figure 3).

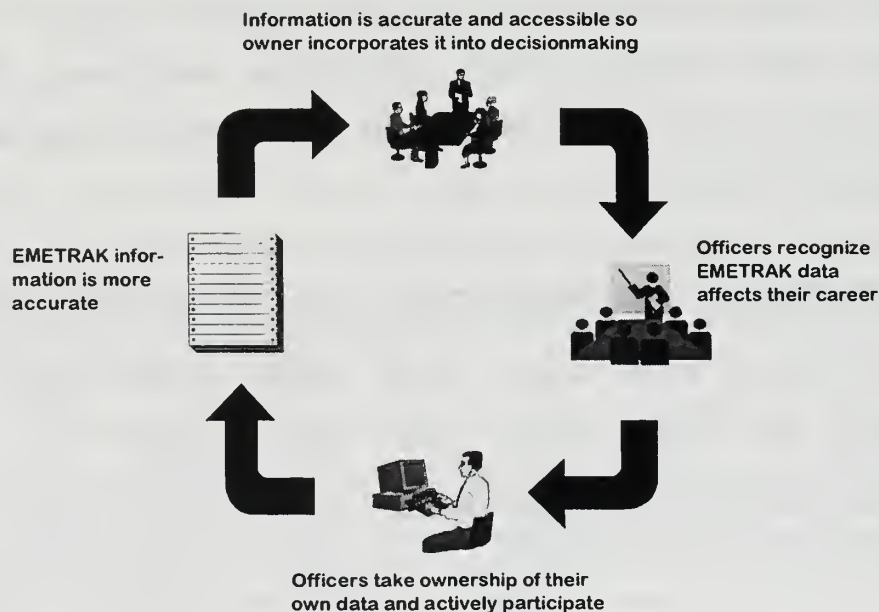


Figure 3. Data Verification Process

The multi-user system offers additional intangible benefits over each of the other alternatives. The first of these benefits is the increased speed of response to customer updates, queries, and reports. By distributing the application and moving many of the system functions out of a central program office and closer to the customer, response time for information should dramatically decrease. Moreover, the availability of program information should not be limited to the business hours of the EME program office. With an on-line system such as that envisioned in Alternative 3, customers could simultaneously access the system 24 hours a day. Finally, a distributed multi-user system would also allow the data entry function to be moved closer to the input source at the MTF, thereby increasing data accuracy and reducing data entry delays.

c. Cost-Benefit Analysis Conclusions

The objective of the economic feasibility analysis was to examine the costs and benefits associated with the development of an information system. Three alternatives were examined and the present value costs of satisfying a given set of requirements are summarized in Table 5.

Alternative	System	PV Cost
1	Manual	\$666,400
2	Single-user DBMS	\$398,242
3	Multi-user DBMS with distributed I/O	\$548,288

Table 5. Present Value Cost Summary

Alternative 2 is the least cost solution and it should be selected if tangible benefits are the major evaluation factor and if the project continues to match the assumptions stated in the cost-benefit analysis. Alternative 3 provides a number of intangible benefits which could be benefit the EME program. If the value of these intangibles to the EME program is greater than \$150,046 (or the difference between Alternatives 2 and 3), then Alternative 3 should be selected.

Alternative 3 costs appear to exhibit economies of scale if the scope of the EME program expands significantly. This does not appear to be the case for Alternatives 1 and 2, as their marginal costs will quickly begin to rise if the program continues to expand. Therefore, if the EME Program expands its officer base or is adopted as a DOD-wide program, then Alternative 3 should be seriously considered. If this situation develops and a phased implementation strategy is adopted, Alternative 2 would provide an excellent migration path to the multi-user distributed application.

4. Technical Feasibility

A single user application developed using a fourth generation language (4GL), which closely involves the end-users, and which employs rapid prototyping techniques does not pose significant technical risk. Technical feasibility, however, is clearly the focus risk factor in Phase II of the project. Remote multi-user database operations have been performed within the MANs and LANs of Navy Medicine for several years but, to date, they have possessed only crude user and graphical interfaces. Operating a client-server database management system across a WAN using the Internet is still a serious technical challenge.

Although the Phase I system will not use telecommunications links between sites to access system data, the infrastructure known as Medical Open Architecture (MED-OA) is in place for future development of an on-line system. The chief benefit of the MED-OA initiative, which was begun several years ago, was the standardization of hardware, network architectures, and applications throughout Navy Medicine. MED-OA provided the means through which all Navy MTFs could have connectivity via electronic mail and the Internet. The MED-OA infrastructure now primarily supports the functionality of the Composite Health Care System (CHCS), which is the DOD-wide patient scheduling and appointment system, but it can serve as a medium for a number of other applications.

The on-line system envisioned in Phase II would not require heavy transaction processing. Data throughput requirements, therefore, are anticipated to be low and a

major technical hurdle could be overcome by using MED-OA and the NMDN backbone for data communications. The NMDN WAN connects regional MANs through relatively small capacity 56 kilobits per second (kbps) digital connections (Figure 4). Internal connectivity between the hospitals and clinics within a metropolitan area is more robust with T-1 connections and the availability of DS-1 data rates (1.54 megabits per second - Mbps). Some MANs even have Fiber Distributed Data Interface (FDDI) connections with 100 Mbps data rates available between several of the medical facilities within that regional area.

Detailed MAN topologies were provided by the Navy Medical Information Management Center (NMIMC) and are included in Appendix C. The individual MTF LAN architectures were standardized under the MED-OA initiative and are Ethernet networks with Carrier Sense Multiple Access/ Collision Detection (CSMA/CD) access methods and 10 Base T unshielded twisted pair (UTP) wiring which support 10 Mbps

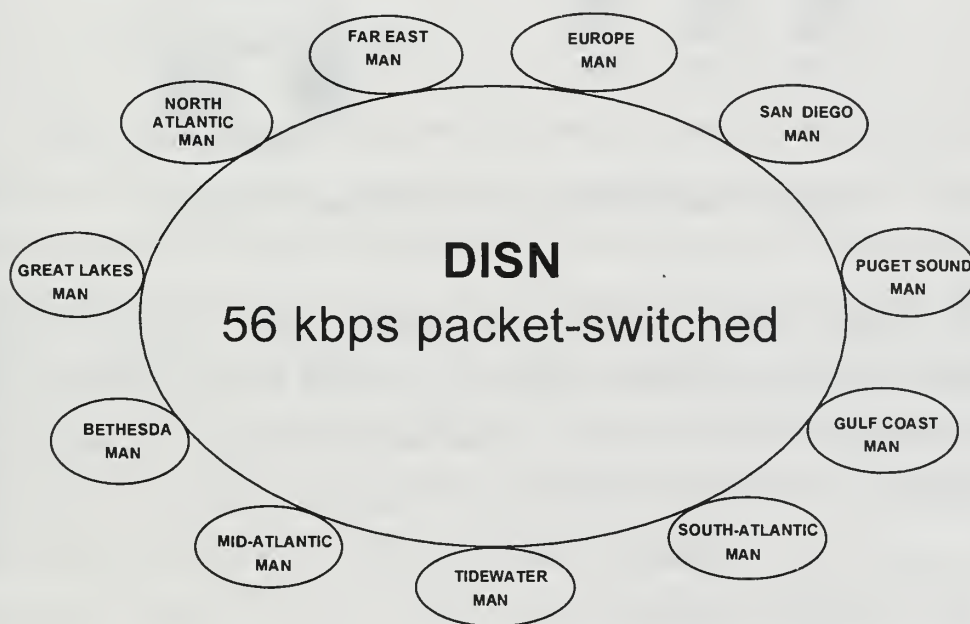


Figure 4. Navy Medical Department Network

data rates. The MTF LANs are connected to regional MAN hubs and DISN through Cisco® routers (Figure 5).

802.3 ETHERNET ARCHITECTURE CSMA/CD

LAN SERVER - AT&T 3B2 BEING UPGR TO HP
MICS - INVENTORY CONTROL
EASIII - EXPENSE ASSIGNMENT SYSTEM
CHCS - COMPOSITE HEALTH CARE SYSTEM

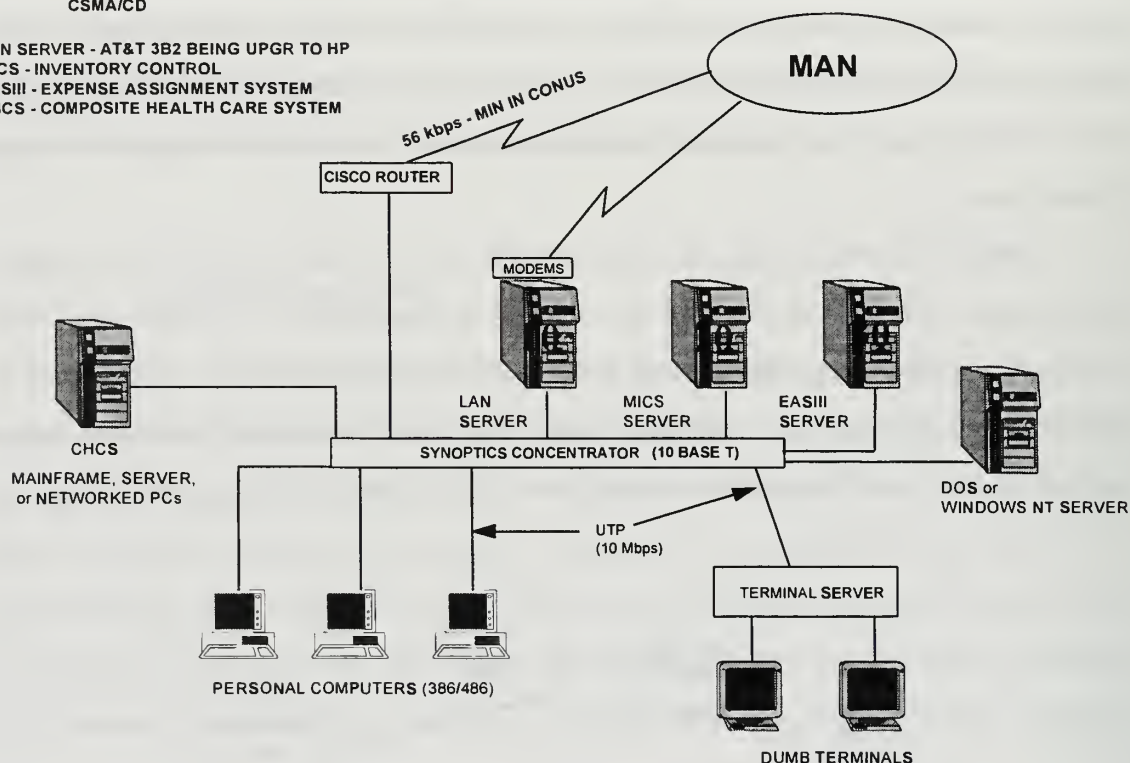


Figure 5. Navy MTF Local Area Network Topology

The primary concern with using the existing NMDN backbone to support EMETRAK is the limited bandwidth provided by the DISN 56 kbps connections which provide connectivity between the MANs. These links must support a number of other medical applications and will inevitably become bandwidth limited as WAN traffic increases in the future. Technically feasible alternatives to using the current NMDN include use of dedicated Integrated Services Digital Network (ISDN) connections to some EME customer sites or dial up access via modem.

5. Schedule Feasibility

Implementation of the EME program curriculum begins within 60 days of project commencement, therefore the use rapid prototyping techniques will ensure that a Phase I prototype application achieves an initial operational capability before the end of FY-95 as specified by the system owner. The long-term requirement for Phase II is not as schedule constrained and will allow a more detailed examination of the critical issues such as bandwidth and connectivity requirements, security concerns, and interoperability with other DOD and Navy systems. Development of a Phase II system can be achieved by the end of the third quarter of FY-96. This allows two months for system design, four months for system development, two months for testing, and one month for distribution and installation.

G. LESSONS LEARNED DURING THE SYSTEMS ANALYSIS PHASE

1. Requirements Review

Systems analysts and programmers are fearful of changing requirements. Change, however, is the only constant in the systems development process and IT professionals continue to deal with changing requirements in every project. Customers frequently reassess their requirements as a result of the questions and issues raised by the analyst during the detailed investigation of the business processes. Usually an agreement between the system owner and systems analyst is reached before the requirement is finalized and a specification is developed. If agreement is not reached then requirements are likely to change during the course of systems development.

One such issue arises in the Systems Analysis phase of the EMETRAK project. The system owner desires a statistical reporting capability for competencies attained by officers enrolled in the program. This presents a problem for the analyst because the curriculum is still under development and the EME Program Management Group is having difficulty determining which courses are required to complete a specific

competency at this stage of curriculum development. In the absence of defined criteria for competency definition, the measurement of completed competencies and statistical analysis of the data are impossible. The competency issue is a difficult one and remains unresolved at the conclusion of the Systems Analysis phase. Although a problem exists with the requirement for statistical reporting at this stage, delays in the development of a prototype are not anticipated. The completed competency issue is an example of a business rule problem which should be addressed by EME Program Management Group if the requirement for statistical reporting is to be incorporated into the production version of EMETRAK.

The lesson learned from this example is that it is the analyst's responsibility to determine which issues are business problems and which can be solved through the implementation of technology. The analyst must recognize the distinction between business and technology issues and communicate those to the system owner. If the owner and analyst frequently review the requirements at this phase of the SDLC, then problem areas can be identified and changes to system requirements can be incorporated with little expense or delay. Changes to the system requirements which occur in later phases of a project are more costly to implement and can delay fielding of the production system.

2. Life Cycle versus Bottom-Line Costs

A considerable body of literature exists which addresses the subject of identifying total life cycle costs in a cost-benefit analysis for IT systems development. While this method captures the true cost of a system over its life cycle, it is not always understood or even used as a practical estimate for DOD program managers who deal in real dollars and whose programs are judged by their price tags in the current year. While the cost-benefit analysis for this project looks at the total projected life cycle costs discounted over seven years, the program manager is more concerned with the straight bottom line costs of the system hardware and software as they relate to the annual program budget.

3. System Owner-Systems Analyst Relationship

A strong relationship is required between the system owner and the systems analyst in order to complete a successful development effort. The quality of that relationship can not be overemphasized; it must be based on mutual trust and credibility.

The owner relies on the analyst to provide a technical solution which solves a particular problem and, often times, must meet strict operational, economic, and schedule constraints. This situation requires that the system owner trust the analyst because every facet of the owner's business environment and organizational processes will be exposed to investigation and analysis during the development of the IT system. The analyst, in turn, trusts the owner to establish an atmosphere where free access to the organization's people and resources are possible in order to complete a thorough study of the environment.

Establishing credibility with the system owner at an early stage of the development process is another important consideration. Political support may be required when dealing with difficult internal organizational issues or policies and having credibility with the system owner makes the job of getting political support a little easier. This type of support may be particularly crucial when process improvement is required within the organization rather than attempting to automate a flawed business process.

The rapport between the EME Program Management Group and system analysts during the Systems Analysis phase of this project has been outstanding. The system owner's support and interest enabled a thorough study of the business environment and system requirements, allowing the EMETRAK project to move forward without delay.

1. The first part of the paper discusses the importance of maintaining accurate records of all transactions. This is essential for the proper management of the company's finances and for ensuring compliance with relevant regulations. The second part of the paper describes the various methods used to collect and analyze data. This includes both qualitative and quantitative techniques, as well as the use of statistical software. The third part of the paper presents the results of the study. This includes a detailed analysis of the data and a discussion of the findings. The fourth part of the paper concludes the study and provides recommendations for future research. This includes a discussion of the limitations of the study and suggestions for how to improve the research in the future.

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III. SYSTEMS DEFINITION PHASE

A. METHOD

The purpose of the Systems Definition phase is to define the business rules and requirements of the proposed system without consideration of a specific technology or implementation. This is accomplished by translating the user-identified capabilities into implementation-independent models that describe desired system functionality. Implementation-independent models reduce the risk that functional requirements will be missed during systems design because of preoccupation with technical details. [Ref. 5, p. 305] Two types of conceptual modeling techniques are used to describe the proposed system: process and data models.

B. THE CURRENT ENVIRONMENT

Administration of the EME program is characterized by manually intensive processes. Scheduling, coordination, and confirmation of classes is conducted through postal mail, electronic mail, telephone conversations, or via facsimile transmissions. Class attendance is recorded on hand-written rosters circulated by the instructor at the course delivery sites. Instructors deliver class rosters and course evaluations to the EME program office for processing by the administrative staff upon returning from a teaching assignment.

The EME administrative staff have access to and use office automation applications for routine word processing, presentation graphics, and limited spread sheet functions. Course completion letters and certificates are generated by word processing application several days after class rosters are delivered to the program office. Once course completion letters and certificates have been processed they are mailed to an officer's command. Verification of officer data is accomplished through feedback from

the individual officer via electronic mail, telephone, or facsimile. Results from course evaluations are collated and entered into a spread sheet application for further analysis by the EME program management group. Paper copies of all class rosters, completion letters, certificates, and course evaluations are stored at the NPS program office.

Program data is not recorded in a single application or stored in a central location, therefore, information is not easily retrievable. This situation adversely impacts the reporting capability of the system. Reports are ad hoc and manually generated from data appearing on class rosters, spread sheet print-outs, or internal memoranda which is very time consuming.

The primary challenges in the current system are timely data collection, data verification, and information retrieval. The scope in the proposed system, therefore, must incorporate the stakeholders, namely the officers themselves, in the information process at the MTF level. It must also be capable of supplying the EME staff at NPS, the EME program manager at NSHS, BUMED, and the Medical Department Corps Chiefs with information to successfully manage the EME program. Finally, the new system must include BUPERS in its scope for importing basic officer information to overcome current data accuracy and data verification problems.

C. THE PROCESS MODEL

Process modeling is a technique for organizing and documenting a system's business processes, inputs, outputs, and data stores. The process model consists of decomposition and data flow diagrams. [Ref. 5, p. 350]

1. Decomposition Diagrams

Decomposition diagrams graphically portray the user requirements in terms of system functions and processes. They serve as a blue print for the structure of the system

from which data flows are modeled. The EMETRAK decomposition diagrams have three levels (zero, one, and two) that identify key system processes.

a. *Level Zero*

The level zero or overview decomposition diagram (Figure 6) depicts three subsystems: data maintenance (process P1), analysis (process P2), and reports (process P3).

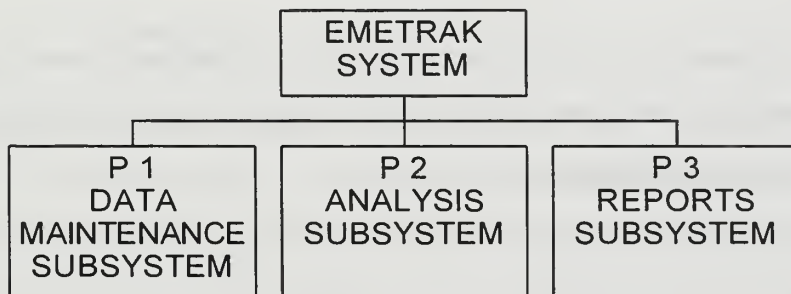


Figure 6. Level Zero Decomposition Diagram

b. *Level One*

Level one diagrams decompose each subsystem into subordinate processes. These processes correspond to the information system functions specified in the previous chapter. Subordinate processes which have pound signs (#) next to the process number indicate the lowest level logical function.

Processes P 1.1 through P 1.5 (Figure 7) conform to the functions required to collect, maintain, and manage data identified by the system owner during the analysis phase.

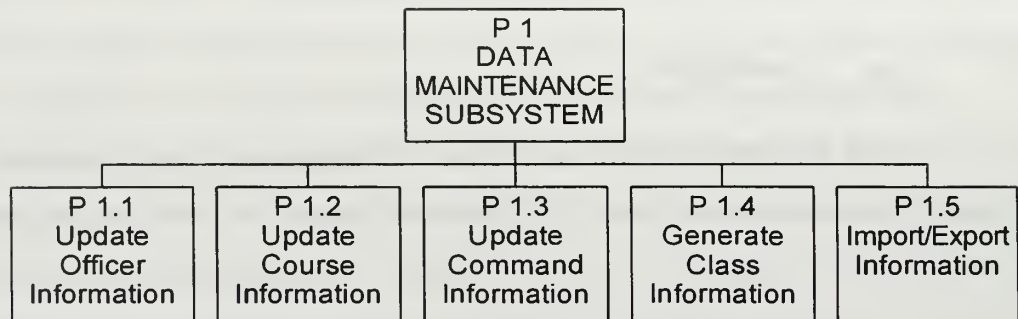


Figure 7. Level One Process One Decomposition Diagram

Processes P 2.1# through P 2.3# (Figure 8) reflect the three general types of queries identified in the information system functions section of the previous chapter: structured, interactive, and statistical.

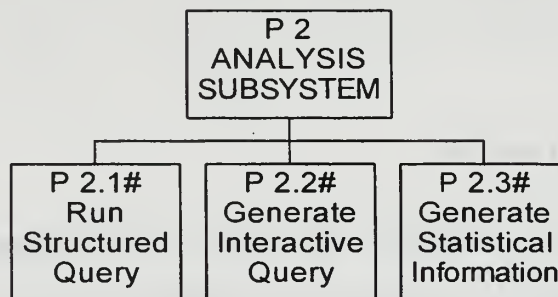


Figure 8. Level One Process Two Decomposition Diagram

Processes P 3.1# through P 3.3# (Figure 9) identify the general categories of reports requested by the program manager. Reports are closely related to system queries, however, they are modeled as distinctly different logical processes during systems definition.

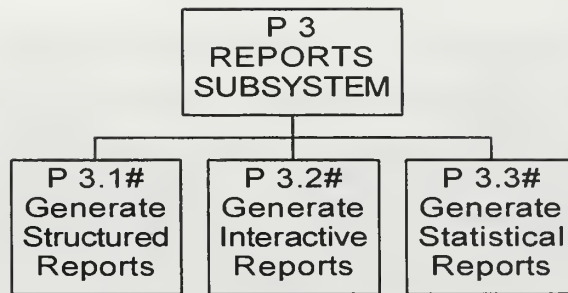


Figure 9. Level One Process Three Decomposition Diagram

c. *Level Two*

The level two diagrams (Figure 10) depict the lowest level logical functions of the proposed system. The *Update Officer Information* process (P 1.1) is decomposed into the add officer, modify officer information, delete officer, and change location sub-processes (P 1.1.1# through P 1.1.4#). *Update Course Information* (P 1.2) decomposes into the add course, modify course information, and assign course to competency sub-processes (P 1.2.1# through P 1.2.3#). *Update Command Information* (P 1.3) is comprised of the add command, modify command information, and delete command sub-processes (P 1.3.1# through P 1.3.3#). *Generate Class Information* (P 1.4) contains the add class and modify class information sub-processes (P 1.4.1# through 1.4.2#). The last level two process, *Import/Export Information* (P 1.5), consists of the create backup, import BUPERS data, database file import, and database file export sub-processes (P 1.5.1# through 1.5.4#).

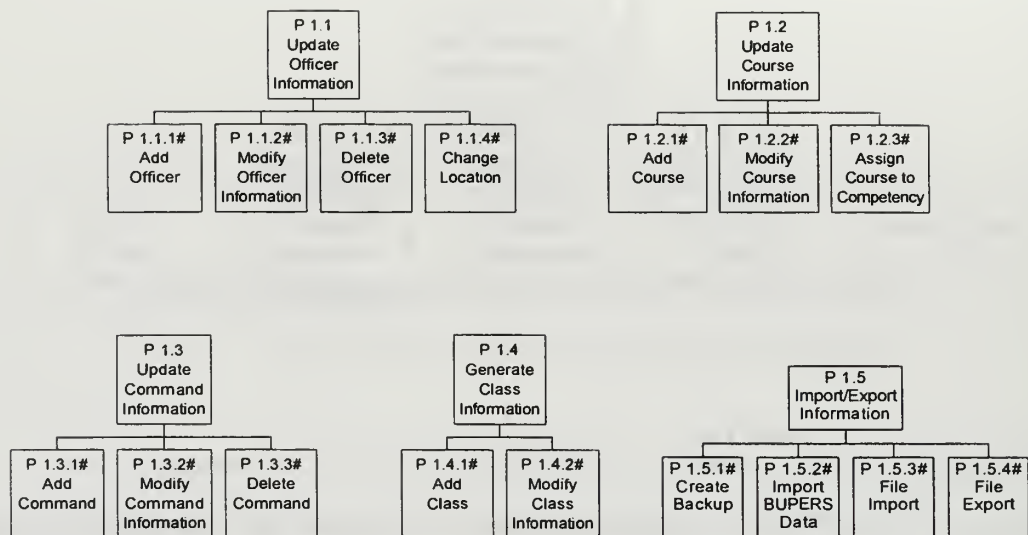


Figure 10. Level Two Decomposition Diagrams

2. Data Flow Diagrams

Data flow diagrams (DFD) model the flow of data through a system's essential processes. They combine information from both the context and decomposition diagrams into a series of charts showing entity, data, and process interactions. Recall that a context diagram identifies which external entities interact with the system and decomposition diagrams identify the essential system processes. In a DFD, data is input by external entities, transformed by system processes, and output to other external entities. The convention followed is the Gane and Sarson symbol set which uses processes, data flows, internal or external entities, and data stores [Ref. 5, pp. 350-352]. Further, the explosion technique is used to diagram data flows wherein essential processes illustrated in the overview diagram (Figure 11) explode to greater levels of detail in subsequent charts (Appendix D).

a. **Overview DFD**

The overview DFD contains all of the entities depicted in the EMETRAK context diagram and shows how they logically interact with the three major system processes: maintain data, conduct analysis, and generate reports. There is only one data store at the overview level, but it is divided into smaller data stores in lower level DFDs.

Process P 1 receives data input from the EME staff at NPS (EME), the program manager (NSHS), BUPERS, and the customer sites (MTFs). Process P 1 then transforms (i.e. adds, modifies, or deletes) the data and sends the output, “updated program information”, to temporary storage in DB.EMETRAK.

Processes P 2 and P 3 perform similar operations on EME data and produce various queries or reports for the requesting external entities.

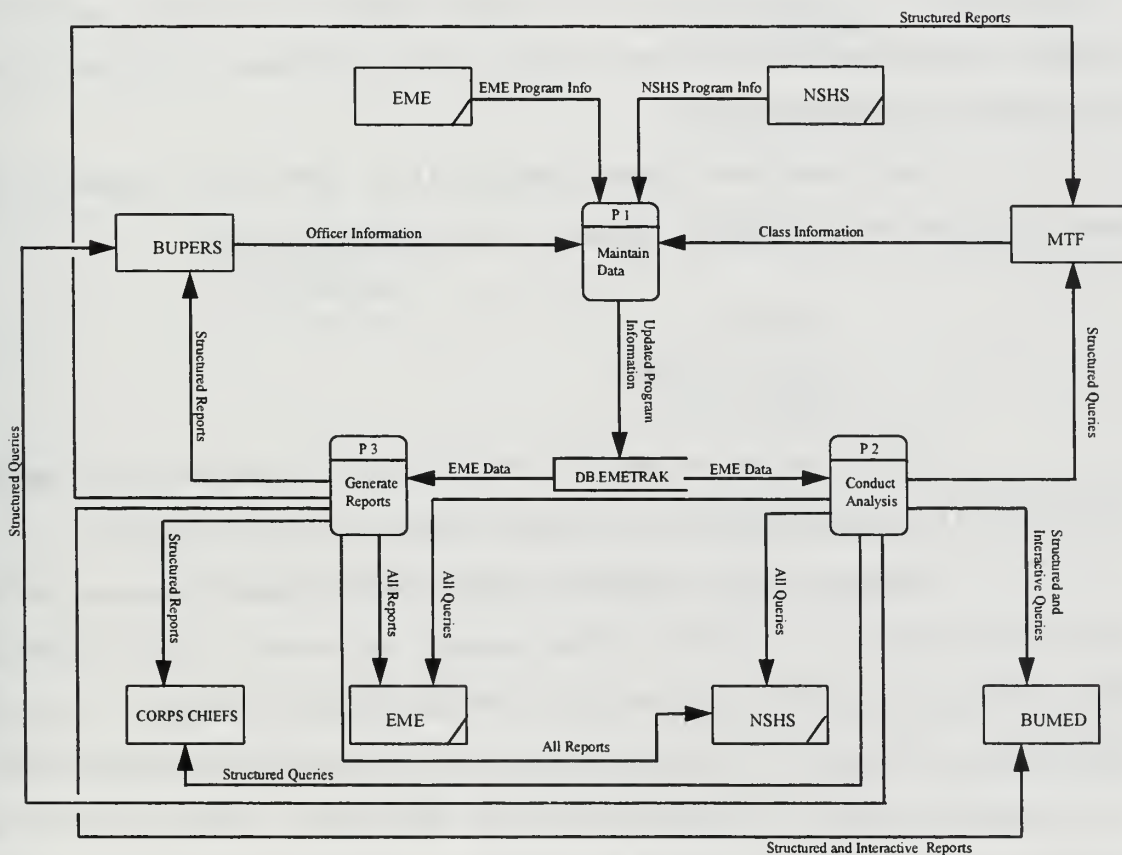


Figure 11. Overview Data Flow Diagram

b. Level One DFDs

Level One DFDs detail the major processes identified in the decomposition diagram and the overview DFD.

In the Level one-Process one chart (Appendix D, p. 107), EME provides officer and course data inputs, NSHS provides command and billet information, MTFs submit class rosters, and BUPERS provides the master Officer List. Each sub-process (P 1.1 through 1.5) transforms the data flows into “updated information” for the DB.EMETRAK data store. The MTFs provide feedback to the system in the form of “verified officer information” to the *Update Officer Information* process (P 1.1). The only output at this level is the “file export” data flow to the program manager (NSHS).

Level one-Process two (Appendix D, p. 108) shows “program data” flowing from the data store (DB.EMETRAK) and being transformed into either a “structured query”, “interactive query”, or “program statistics”. The query capability is available to all external entities, however, statistics are only provided to EME and NSHS for program management purposes.

Level one-Process three (Appendix D, p. 109) is very similar to the previous diagram but for structured, interactive, and statistical reporting.

c. Level Two DFDs

In level two, the process one functions are more closely examined and the DB.EMETRAK data store is divided into smaller logical data stores (Figure 12).

Process 1.1 adds, modifies or deletes basic officer information in the system (Appendix D, p. 110). The external agencies that interact with the system are EME, NSHS, and the MTFs. EME or NSHS provide “officer information” to the *Add Officer* process (P 1.1.1#). The MTF provides “verified of officer information” and P 1.1.1# transforms the two data flows into a “new officer entry” which is placed in the OFFICER data store (DS 1). In P 1.1.2#, EME or NSHS provide “additional officer information” which is used to modify existing data in DS 1. In P 1.1.3#, EME or NSHS

provide the “officer identification number” which is transformed into an “officer to delete” data flow. In the last process, *Change Officer Location* (P 1.1.4#), EME or NSHS provide a “new location” which is transformed into an officer’s “new officer location” in DS 1.

Process 1.2 (Appendix D, p. 111) adds or modifies course information in the database or assigns a course to an EME competency category. EME or NSHS provide “new course” or “additional course data” input. The *Add Course* and *Modify Course Information* processes (P 1.2.1# and P 1.2.2#) transform their respective data flows which update information in the COURSE data store (DS 2). EME or NSHS also provide “course and competency information” which is transformed into a “new competency classification” and is stored in the COMPETENCY data store (DS 5).

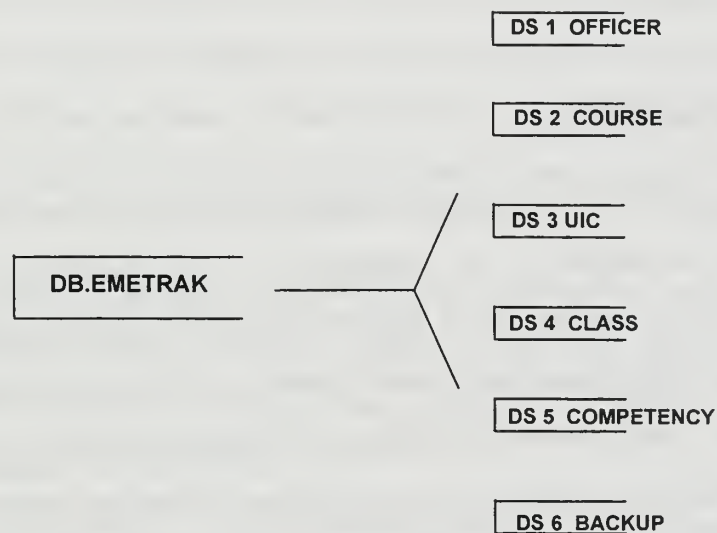


Figure 12. EMETRAK Data Decomposition Diagram

Process 1.3 (Appendix D, p. 112) adds, modifies, and deletes command information of EME participants. NSHS provides input to the *Add Command*, *Modify Command Information*, and *Delete Command* processes (P 1.3.1#, P 1.3.2#, and P 1.3.3#). Each process performs an operation on the data which updates the UIC data store (DS 3).

Process P 1.4 (Appendix D, p. 113) addresses adding classes and modifying class information. The *Add Class* process (P 1.4.1#) receives input from EME, the MTF and the COURSE data store (DS 2). EME provides “verified officer information” and the MTF provides the validation of a class occurrence by initiating the “class roster” input. The process also extracts the course number and course name from DS 2. All inputs are transformed into a new class occurrence for a specific officer in the CLASS data store (DS 4). *Modify Class Information* (P 1.4.2#) simply receives input from EME and modifies existing data in DS 4.

Import/Export Information (P 1.5) defines the utility functions of the system (Appendix D, pp. 114-117). P 1.5.1# shows the system back up function, process P 1.5.2# illustrates the BUPERS officer master data file import, and processes P 1.5.3# and P 1.5.4# depict the file import/export functions between the EME office at NPS and the program manager.

D. THE DATA MODEL

A major goal in the early stages of database development is to build a data model that documents the entities to be represented in the database, to determine the characteristics of those entities, and to describe the relationships among them. A method known as semantic object modeling is used to study and document the entities, known as semantic objects, to be stored in the database. A semantic object is a representation of something identifiable in the user’s work environment or business process. It is a “named collection of attributes” that sufficiently describes a distinct identity [Ref. 9, pp. 79-81]. The “named collection of attributes” represents all of the characteristics that the users need to accomplish their tasks. The SALSA® software application is used to construct semantic object diagrams and, ultimately, a database schema. Semantic object diagrams summarize the structures of objects in a system and visually present them.

1. Semantic Objects

Five internal entities or objects in the EMETRAK system identified in the previous chapter are modeled: OFFICER, UIC, CLASS, COURSE, and COMPETENCY. A new object, COURSECOMP, is also modeled that describes an instance of an EME course assigned to a particular competency category.

The OFFICER object (Figure 13) describes an officer enrolled in the EME program. The officer is uniquely identified by the SSN and has a group attribute called *OfficerName*. The *OfficerName* group attribute consists of the *LastName*, *FirstName*, and *Minitial* simple attributes. Other simple attributes that describe the officer are *Rank*, *BSC* (billet sequence code), *Designator*, *Subspecialty*, *JobTitle*, and *Email* (address). The OFFICER object is related to the UIC and CLASS semantic objects. The integers to right of the object attributes are the attribute's minimum and maximum cardinality. The minimum cardinality is the minimum number of instances of the attribute that must exist for the object to be valid. The maximum cardinality indicates the maximum number of instances that an attribute may have. In the OFFICER object, the officer is related to one and only one (1.1) command (UIC) and may be related to zero or many (0.N) instances of a CLASS.

The UIC object is uniquely identified by the *UICNumber* attribute. It has the following additional attributes: *UICName*, *Address*, *Phone*, and *HealthSvRegion*. The UIC object may have from zero to many officers assigned as indicated by the cardinality of the OFFICER object contained within UIC.

The CLASS object has a unique composite identifier consisting of the OFFICER ID (*Ssn*) and COURSE ID (*CourseNumber*). The CLASS object is an instance of an officer taking an EME course on a specific date. The CLASS attributes are *ClassDate*, *Instructor*, and *CourseLocation*.

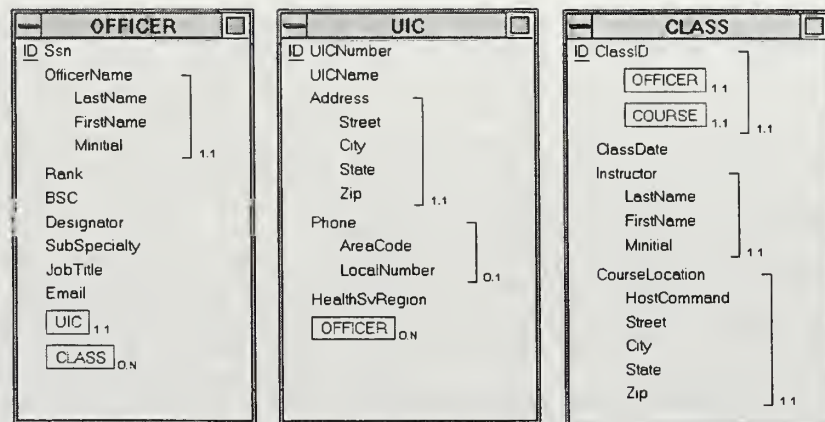


Figure 13. OFFICER, UIC, and CLASS Semantic Objects

The COURSE semantic object (Figure 14) describes an EME course offering. It consists of the *CourseID*, *CourseName*, *Hours*, *CEUCredits*, *CourseDesc* (description), and *CourseSponsor* attributes. A COURSE may be related to zero or many instances of CLASS but must belong to at least one competency category (COURSECOMP).

The COURSECOMP object is identified by a composite identifier consisting of *CourseID* from the COURSE object and *Competency* from the COMPETENCYCAT object. The COURSECOMP object models an intersection relation between the two objects which will be helpful during database implementation to overcome certain data anomalies described in the next chapter.

The COMPETENCYCAT object is uniquely described by the *Competency* attribute which is simply the EME competency category title.

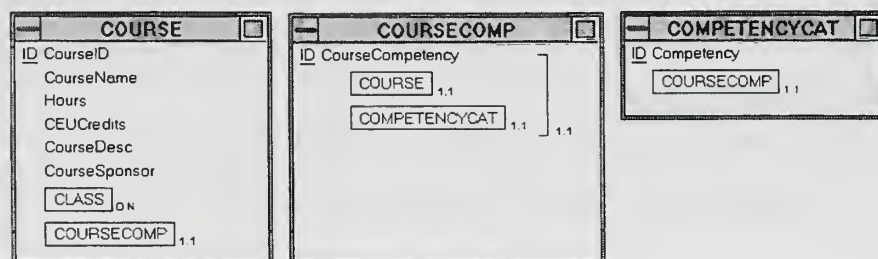


Figure 14. COURSE, COURSECOMP, and COMPETENCYCAT Semantic Objects

E. LESSONS LEARNED DURING THE SYSTEMS DEFINITION PHASE

The modeling techniques used in this phase facilitated a comprehensive study of the business processes employed by both the EME program management group and administrative staff. The capabilities desired by the system owner and users drove the detailed nature of the study. Translating those desired capabilities into proposed system functions required a thorough understanding of the day-to-day administrative procedures as well as the overall EME program management strategy and objectives. The techniques discussed in this chapter helped achieve that goal.

Two key decisions occurred during the Systems Definition phase that impact the future development of the EMETRAK system. First, the program manager at NSHS expanded the scope of EMETRAK concomitant with the two-phased development strategy articulated in the previous chapter. The concept for the development of a multi-user database application, accessible from every major Navy MTF, was approved and funded as part of the FY-96 program budget. This decision reinforced the notion of using a 4GL rapid application development tool to build a working prototype.

A working prototype would provide the EME staff with an immediate data collection and reporting capability while a final production system is developed. Moreover, the prototype system could serve as an adjunct to the written requirements specification to more accurately define multi-user requirements in terms of data structures, user interface, and system outputs.

The second decision was approval of the concept to partner with the Defense Manpower Data Center (DMDC) to develop the multi-user system (Phase II). The terms of the partnership are not final, but they involve developing the requirements specification as part of this study and turning those products over to DMDC programmers for coding and testing. Under this plan, the EME Program would reimburse DMDC for the level of effort and materials required for system development. While the exact level of effort required is undetermined at this stage, a DOD partnership should result in significantly lower development costs compared to those predicted in the cost-benefit analysis.

IV. SYSTEMS DESIGN PHASE

Database and application design are the major themes of this chapter. The relational model is the foundation for database design and applies to both the single-user and multi-user versions of EMETRAK. Application design, however, focuses on the design of specific database components and the user interface. These components are peculiar, in some cases, to Microsoft Access® therefore application design issues as discussed in this chapter are restricted to the single-user system (Phase I). Multi-user application design issues are addressed in a subsequent chapter.

A. DATABASE DESIGN

Transformation of the semantic object model into a relational database design is a two step process. First, the semantic objects are converted into a relational model. The relational model is important because it expresses a database management system (DBMS) independent design. The relational model is comprised of relations which are two-dimensional tables storing data pertinent to the original semantic themes. Representing semantic objects as relations facilitates normalization. Normalization is a fundamental concept in relational database design and is the process of converting a relation that has certain problems into two or more relations that do not have these problems. [Ref. 9, p. 125] The problems alluded to are known as modification anomalies and refer to operations requiring several steps to either insert or delete data as opposed to one atomic operation that updates data in multiple related tables at once.

The second step in the transformation process is constructing a database schema. The database schema is a set of rules that defines the relational database structure, its domains, tables, and relationships. A database schema can be thought of as data that describes the database. Most modern database modeling tools, such as SALSA®,

automatically generate a database schema which is imported into a specific DBMS as a template for the application's database tables.

1. Relational Model

Relations consist of rows, also known as tuples, and columns. The intersection of the rows and columns are called cells. In order to qualify as a relation, a table must conform to some basic rules which govern the content of its rows, columns, and cells [Ref. 9, p. 126]:

- Each cell in a table must be single-valued (no repeating groups or arrays are allowed)
- Each column in a table must have a unique name
- All entries in a column must be of the same kind (or theme)
- All rows in a table are unique (no two are identical)
- The order of the rows or columns in a table is insignificant

The unique names of the columns in a relation are called attributes. These attributes correspond to the same attribute names represented in the semantic object model in Chapter III. Unique rows in a relation are identified by an attribute called the primary key. Notice that no two rows in a relational table can have the same primary key and duplicate data as this violates the rules of a relation. The ID attributes from the semantic object model become primary keys in the relational model and eventually in the database tables.

One of the reasons for selecting the semantic object modeling technique was that relationships between semantic objects, and ultimately relations, are automatically generated by the software modeling tool. The only manual task required of the developer is to identify many to many (M:N) relationships between objects and divide these into separate one to many (1:N) relations to comply with standard normalization rules. The

other advantage of using semantic object modeling is that normalization problems associated with relational database design are less likely than with other methods such as entity-relationship models because objects already conform to semantic themes. This is the essence of normalization - every normalized relation has a single theme.

Relations are further classified by the types of modification anomalies to which they are vulnerable. Without explaining the details of each normal form, suffice it to say that the goal for the EMETRAK relational model is third normal form which eliminates most of the modification anomalies. A relation in third normal form has the following characteristics:

- A table containing data must meet the definition of a relation
- All of the non-key attributes in a relation depend on all of the primary key
- None of the attributes of relations have transitive dependencies

The EMETRAK relational model consists of six relations and their corresponding relationships (Figure 15). The underlined attributes represent primary keys in a relation and italicized attributes represent foreign keys. Foreign keys are the linking mechanism to a related table. Notice that foreign keys in one relation are the primary key in a linked relation. Lastly, the cardinalities from semantic object attributes transform into relationships in the relational model.

a. UIC Relation

An instance or single occurrence in the UIC relation is uniquely identified by its UIC Number which is the primary key. A UIC may have from zero to many officers assigned but an officer must be related (assigned) to a specific UIC. The UIC and OFFICER relations are linked through a foreign key (UIC) appearing as an attribute in the OFFICER relation.

b. OFFICER Relation

An officer is identified by a unique SSN and may have completed from zero to many classes. However, a CLASS occurrence must be related to an OFFICER instance to exist.

c. CLASS Relation

The CLASS relation is an occurrence of an officer taking an EME course. The primary key in the CLASS relation is a composite key consisting of foreign keys from both the OFFICER and COURSE relations. These foreign keys link the two relations to CLASS. A CLASS must be related to an occurrence of COURSE to exist.

d. COURSE Relation

A COURSE is identified by a unique course number - the CourseID attribute. A COURSE may be related to zero or many occurrences of CLASS. A COURSE may also belong to several EME competency categories.

e. COMPETENCYCAT Relation

The COMPETENCYCAT relation represents the various competency categories addressed by the EME program. An instance in the COMPETENCYCAT relation is identified by the competency title specified in the program literature. A competency category has many associated courses and an EME course may belong to several competency categories. This situation represents a many to many (M:N) relationship which is susceptible to a variety of modification anomalies during database implementation. Normalization rules require that many to many (M:N) relations be divided into two or more one to one (1:1) relations to reduce modification anomalies. The solution is constructing the intersection relation COMPCOURSE.

f. COMPCOURSE Relation

The COMPCOURSE intersection relation stores very little data; it is simply a listing of EME competencies and associated course numbers. The composite primary key for the COMPCOURSE relation consists of foreign keys from the COMPETENCYCAT and COURSE relations.

The many to many relationship between the course and competency category relations only became apparent during the development of the relational model. The semantic object model had to be later modified to reflect the development of the new intersection relation.

2. Database Schema and Table Generation

SALSA® generates the database schema in an exportable format. The schema is then imported into the DBMS application and the basic structure for database tables is developed from the semantic object domain, attribute, and relationship code. Although somewhat automatic, the table generation process still requires the developer to perform minor modifications on table relationships, attribute names, and field lengths. Once the tables are generated in the DBMS application, developers can begin to focus on application and user interface design.

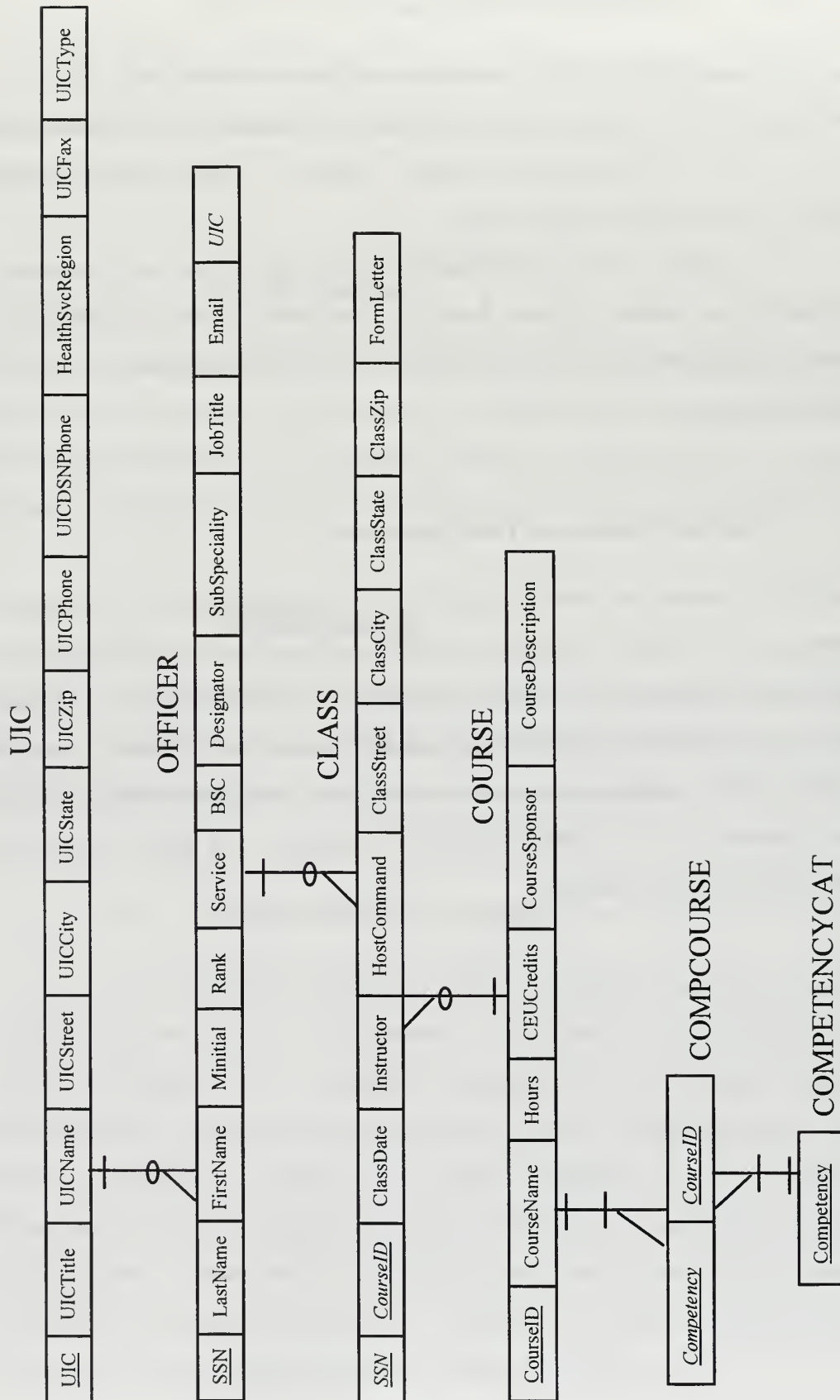


Figure 15. Relational Diagram

B. APPLICATION DESIGN

1. General Considerations

When designing the EMETRAK prototype application, several factors and considerations were taken into account. First, the application was designed to fulfill the system owner's requirements and support the EME program objectives. Second, since end-users were not likely to use the application every day, it had to have an intuitive and user-friendly interface. Finally, the prototype had to provide clear and complete specifications to the programmers who would later be developing the multi-user system. Consequently, application design required close coordination between the developers, the system owner and several prospective end-users. The system owner was involved in the approval of form, query, and report design and approved each component for logic and correctness. Because the EMETRAK Phase I application was a prototype design, some sacrifices in efficiency, security, and error handling were accepted in favor of rapid application development.

2. Principles of Interface Design

The Microsoft Windows® basic user interface design principles described by the event driven programming model were adhered to during application design. [Ref. 10, p. 34-35]

- **User in Control** - In the event driven programming model, the application should be the servant not the master. The user controls the actions of the application not the reverse.
- **Directness** - The application should be straight-forward in its design. Users do not want to deal with files, bytes, etc. The user should be able to select an object (form, input box, button, etc.) and perform an action on that object.

- **Consistency** - End-users want to know what to expect in an application. The sooner a user is comfortable with the application, the sooner they stop working with a program and start using a tool.
- **Clarity** - The design should have intuitive entry forms and message boxes for data exchange. The entities represented in the tables should have one theme and make sense.
- **Aesthetics** - Color and layout are important. Users want crisp eye-pleasing displays not garish designs.
- **Feedback** - Providing immediate feedback to end-users when an event takes a substantial amount of time is an important design concept. This feature lets the user know they have temporarily relinquished control of the application while background processing is being accomplished.
- **Forgiveness** - The application should allow the user to recover from mistakes easily and without crashing. Access 2.0 provides a built-in multi-level undo function which was used in the EMETRAK design along with warnings and dialog message boxes.

a. **EMETRAK Design**

EMETRAK was designed with a branching architecture rather than the typical hierarchical menu structure found in many database applications. The application opens directly to a main input form titled *Officer Record* from which the user can immediately view officer information or navigate to other application features. Buttons that “branch” or link to other application functions such as table views, reports, and utilities are all easily accessible on the main input form.

3. Input Forms and Menus

a. Officer Record Form (Figure 16)

Most of the information relevant to an officer enrolled in the EME program appears on the *Officer Record* form. Basic information from the officer data file appears in text boxes in the upper half of the form and a sub-form showing officer transcript information appears on the lower half of the form. By selecting an object-action button on the *Officer Record* form, the user can view information about an officer's command, see how many program hours an officer has completed sub-divided by competency category, or add information on a completed course. Buttons on the *Officer Record* form also allow the user to view system tables, access the reports menu, and edit officer data.

b. Command Info Form (Figure 17)

The *Command Info* form opens when the Display UIC button is selected. The form displays the officer's unit title, address, telephone number, and HSR. Command information may be updated directly on the *Command Info* form.

c. Add New Class Form (Figure 18)

The *Add New Class* form opens on top of the *Officer Record* form when the appropriate button is selected. The *Add New Class* form allows the user to enter completed course information on any officer in the database not just the officer record underlying the form. Upon entering the officer SSN in a text box, the officer's name automatically appears on the form. This provides the user with instant feedback and verification of an officer's name and SSN. An officer must first exist in the database before entering class information.

d. Hours by Competency Form (Figure 19)

Selecting the Competencies button on the *Officer Record* form opens the *Hours by Competency* form. This form shows the number of EME hours completed by the officer grouped by competency category. The system owner agreed to a design that shows hours completed vice completed competency categories because of the unresolved competency issue addressed in the earlier chapters.

e. View Tables Menu (Figure 20)

Selecting the Tables button sends the user to the View Tables menu. The View Tables menu provides the user with the ability to view the COURSE, UIC, or COMPETENCYCAT tables. Users may edit data stored in these tables in the prototype application.

f. Report Menu (Figure 21)

The Reports button on the *Officer Record* form opens the Report Menu. The Report Menu provides the user with a selection of ten pre-formatted reports that can be viewed in a tabular query form, a screen report format, or printed in hard paper copy.

4. Utility Functions

Six buttons on the right side of the *Officer Record* form provide basic record and file utility functions. The user may add a new officer record, save modifications to the current record, find a specific entry in a selected field, toggle to the next or previous record, or exit the application.

C. LESSONS LEARNED DURING THE SYSTEMS DESIGN PHASE

The prototyping approach was used to validate the design of the user interface, screens and reports. It helped clarify system requirements and reduce uncertainty with the system owner during development. The greatest benefit proved to be in soliciting input from the system owner and users who were not exactly sure about what they wanted until they saw it on a computer screen. Moreover, rapid prototyping facilitated constructive user comment and continuous feedback which reduced errors in application design.

Officer Record

EMIE

SSN: 111-11-1111 Name: Tester Todd T

Rank: LCDR Service: USN Desig: 1011 Subspec:

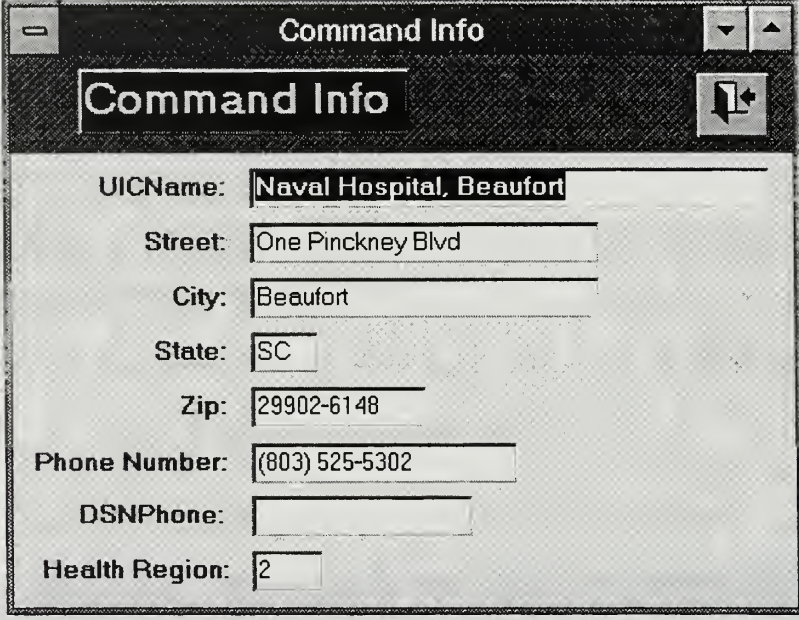
BSC: 11111 Job Title: Head, Testing

UIC: 11111 Display UIC Email: test@tester

Add Class Tables Reports Competencies

Class Date	Course ID	Course Name	Hours	CEU Credits	Sponsor
9/5/94	1	Understanding and Effectively Using Communication Me	4.00	4.00	NPS
6/29/95	1	Meeting Management	4.00	4.00	NPS
1/1/95	9	Stakeholder Management and Mapping the Health Care	8.00	8.00	NPS
9/19/95	9A	Stakeholder Management and Mapping the Health Care	3.00	3.00	NPS
12/31/95	13	Total Quality Leadership - The Application	8.00	8.00	NPS
1/1/95	13	Effective Information Systems	4.00	4.00	NPS

Figure 16. Officer Record Form



Command Info

UICName: **Naval Hospital, Beaufort**

Street: **One Pinckney Blvd**

City: **Beaufort**

State: **SC**

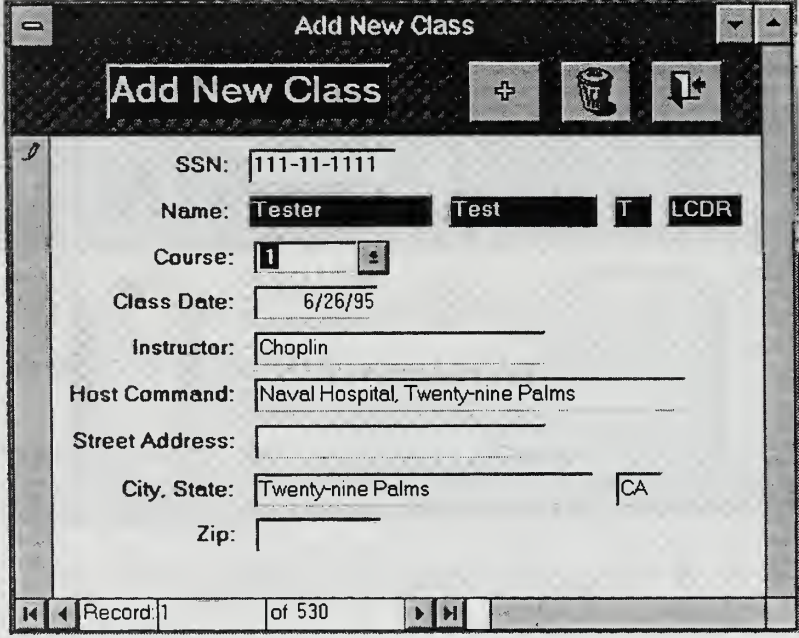
Zip: **29902-6148**

Phone Number: **(803) 525-5302**

DSNPhone:

Health Region: **2**

Figure 17. Command Info Form



Add New Class

SSN: **111-11-1111**

Name: **Tester** **Test** **T** **LCDR**

Course: **1**

Class Date: **6/26/95**

Instructor: **Choplin**

Host Command: **Naval Hospital, Twenty-nine Palms**

Street Address:

City, State: **Twenty-nine Palms** **CA**

Zip:

Record: 1 of 530

Figure 18. Add New Class Form

Hours by Competency		
Competency	How Many Courses	Total Hours
Acquisition Process	1	2
Financial Management	3	6
Individual Behavior	1	2
Information Management	1	4
Managing Change & Tech Innovati	1	5

Figure 19. Hours by Competency From

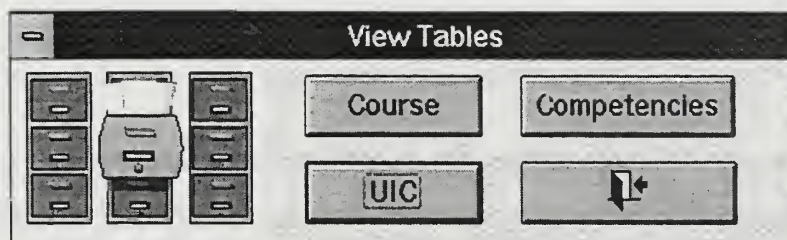


Figure 20. View Tables Menu

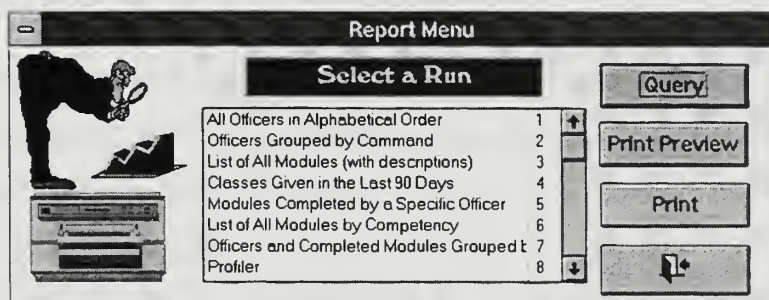


Figure 21. Report Menu



V. EMETRAK PROTOTYPE IMPLEMENTATION

A. PROTOTYPE APPLICATION STRUCTURE

Relational databases apply the principles of the relational data model in which data is organized into logical mathematical sets in a tabular structure. This allows data to be stored more efficiently and with less overhead than older file management or hierarchical systems. Efficiency is measured in terms of memory requirements and access speed.

While efficiency is important, database quality is usually the primary criteria for selecting for a particular database model. The quality of a database is largely determined by the accuracy of the data it stores. Therefore, a primary goal of the relational database model is to preserve data integrity. Integrity is preserved by preventing access to data from outside of the DBMS that created it. In a relational database management system (RDBMS), data can only be accessed through queries handled by the DBMS engine itself. Thus in a relational system, data is stored in linked tables, it is accessed only through DBMS queries, and it is presented in database forms and reports. [Ref. 11, p. 16]

Microsoft Access 2.0® is a true RDBMS application. The database engine provides strong data integrity by limiting access to data and by enforcing robust referential integrity rules. It was selected for development of the EMETRAK prototype system due to its intuitive object-oriented design features, simple query facility, and powerful database engine. Access uses tables, queries, forms, reports, macros, and modules in its DBMS implementation.

1. Tables

A relational database is designed to manage information stored in multiple tables. Tables contain information from a single object class or theme organized into rows and columns. Each row represents an individual record and the columns, called fields, are describing characteristics of that record. Tables are created in Microsoft Access in two ways. A database schema or external DBMS table is imported and converted into an Access table or a new table is created from within the application itself.

The prototype system consists of eight tables that were either created from the imported database schema or developed within the actual application. The EMETRAK table structures are described in the prototype database dictionary (Appendix E).

2. Queries

A query is a method of accessing the database by asking the DBMS a question or by sorting, grouping, or updating database information. These functions are performed by a sub-language known as Structured Query Language (SQL). SQL was explicitly designed to access DBMSs based on the relational model [Ref. 11, p. 27]. Microsoft Access uses its own proprietary version of SQL based on the American National Standards Institute version 89 (ANSI-89 SQL) standard to access data. Access also provides a visual interface to SQL known as query-by-example (QBE) which greatly simplifies writing database queries. Twenty-four queries were written for the prototype system and the significant ones are described in detail in Appendix F.

3. Forms

Database forms are a means of inputting data and presenting DBMS information on the computer screen. Database forms usually emulate paper forms found in an existing system and present the same type of information in a "paperless" format. Forms

are usually based upon system queries written to actually present or manipulate database information. Prototype system forms were described in section B of the previous chapter.

4. Reports

A report is either a paper or on-screen presentation of information. Access 2.0 has a flexible report generation capability that allows the development of reports which closely replicate those used in an existing system.

Eleven reports were developed for the prototype system. The only existing system report which was replicated was the course completion letter. All other reports were developed based upon new input from the system owner. Each report was designed with a similar “look and feel” to present a standardized format. Prototype system reports are provided in Appendix G.

5. Macros

Access provides a powerful capability to manipulate database objects and automate repetitive tasks through the use of macros. A macro is a small menu-driven sub-routine that provides its functionality without requiring complex coding on the part of the developer. Macros were used extensively in the prototype system to quickly develop menus and reports.

6. Modules

A module is a container within Access that stores Access Basic procedures. Access Basic is a programming language that allows the developer to customize database objects by defining methods, properties, and actions through code. The EMETRAK prototype system only has one module. The functions stored in that module are described in Appendix H.

B. REFINING THE PROTOTYPE APPLICATION

Once the basic structure of a prototype database is completed and populated with test data, the developer integrates the various parts into a working application before beginning dedicated system testing. Integration and refinement include such things as verifying table relationships, standardizing form layouts, developing customized menus, providing a back up capability, and establishing user permissions or other security features.

The prototype application was closely reviewed for accuracy of table relationships, keys, and referential integrity rules. Once the mechanics of the tabular structure was verified, the cosmetics of the user interface layout and menu structure were addressed. The color scheme and location of utility buttons on each form was adjusted to provide consistency and clarity. Further, a customized and simplified drop-down menu bar was added to enhance user efficiency. To enable an adequate back up facility, the prototype system was programmed to automatically copy database files to floppy disks using a DOS-based batch file procedure upon exiting the application. Finally, the Access security facility was invoked to enable user log on and password protection. User access was restricted to data entry, viewing, and printing. The user's ability to modify the database design or directly access table structures and other security functions was disabled.

C. OTHER IMPLEMENTATION ISSUES

1. System Testing

Testing is an important activity of the Systems Implementation phase because translation of user requirements into a working system is very complex and error prone. A top-down program development strategy was used for the prototype system to provide a structured approach to both system coding and testing. With the top-down approach,

the developer starts with a high level description and adds system components in a hierarchical fashion. The developer programs in increasing levels of detail until the specified functionality is achieved. Moreover, each module is tested along the way for interoperability with its parent or other related module. The advantage of this approach is that integration of the components is tested as the application is being developed resulting in smoother systems integration. [Ref. 3, pp. 312-313]

Top-down testing involved both systems integration and unit testing of individual modules. In the prototype application, the highest logical level module was tested first and then each related module was independently tested using up to 250 records of test data. As problems were identified, the logic of the module was corrected until the desired functionality was attained. Each module in the logical structure of the prototype system was unit tested and no major problems were noted at the completion of systems integration testing.

Once system testing was completed, the prototype application was made available to the EME program management group for final verification and validation. Each application function was demonstrated to the group and compared against the system owner's stated requirements. System outputs were closely scrutinized by the system owner and the program manager at NSHS before final approval for installation was given.

2. Training

a. User's Guide

A system user's guide was developed for the prototype application (Appendix I). The usability of the guide was then tested on a randomly selected end-user who was not familiar with either the prototype application or the contents of the user's guide. The end-user was instructed to treat the guide as a tutorial for the prototype application. The session was closely monitored and suggestions from the end-user were included in the final version of the guide before distribution.

application. The session was closely monitored and suggestions from the end-user were included in the final version of the guide before distribution.

b. Formal Training

Two training sessions were conducted for approximately eight end-users before system installation. The training sessions encompassed a review of the user's guide, an application demonstration, and hands-on experience with the prototype. Although formal training was deemed effective by the administrative staff, continuous technical support is anticipated in the months ahead until the multi-user system is fielded.

3. Installation

The prototype application is installed on a networked 486/66 DX2 PC with a 420 megabyte hard drive, 16 megabytes of random access memory, and a network printing option installed. The PC uses Windows 3.11 and the Banyan network operating system. The prototype application runs within the Microsoft Access 2.0 DBMS not as a stand-alone program.

During the installation, the data files were separated from the application and moved to another directory to reduce the possibility of data corruption due to program failure. Consequently, the DBMS tables are attached through address pointers rather than actually residing in the prototype application.

A problem was encountered with activating the network printing option in the prototype application. After consulting with the network administrator, the problem was resolved at the network vice application level and printing was enabled. The final step in installation was activating system security and encrypting the database.

D. POST-IMPLEMENTATION EVALUATION

Evaluation is an important tool in the SDLC to assess the success of a system and recommend improvements for subsequent versions or follow-on applications. Two methods will be used to evaluate the success of the prototype application: 1) establishing a help desk and 2) conducting a user survey. The help desk personnel will not only provide technical support to the end-users, but will also collect data on prototype application problems. Suggested areas for improvement will be incorporated in the multi-user application.

The user survey is a more formal mechanism for evaluating the prototype system. However, the survey will not be conducted until the prototype system has been operational for several months and end-users are thoroughly familiar with the application. Therefore, help desk comments will provide feedback sooner than the user survey.

E. LESSONS LEARNED FROM IMPLEMENTATION

The prototype system was functional and capable of meeting the system owner's basic requirements for data entry and reporting within the six week deadline. However, incorporating more robust capabilities and completing the finished product took considerably longer. A calculation of development hours required revealed that approximately 1050 hours were needed to fully develop the prototype system from the analysis phase through implementation. The function point and comprehensive cost model analyses conducted in the cost-benefit analysis had estimated that approximately 1171 hours would be required to develop the system. Therefore, the conclusion is that the models were an effective tool for estimating development time in this case.

The first part of the paper discusses the importance of the study of the history of the English language. It is a branch of linguistics which deals with the changes in the language over time. The second part of the paper discusses the importance of the study of the history of the English language. It is a branch of linguistics which deals with the changes in the language over time. The third part of the paper discusses the importance of the study of the history of the English language. It is a branch of linguistics which deals with the changes in the language over time. The fourth part of the paper discusses the importance of the study of the history of the English language. It is a branch of linguistics which deals with the changes in the language over time. The fifth part of the paper discusses the importance of the study of the history of the English language. It is a branch of linguistics which deals with the changes in the language over time. The sixth part of the paper discusses the importance of the study of the history of the English language. It is a branch of linguistics which deals with the changes in the language over time. The seventh part of the paper discusses the importance of the study of the history of the English language. It is a branch of linguistics which deals with the changes in the language over time. The eighth part of the paper discusses the importance of the study of the history of the English language. It is a branch of linguistics which deals with the changes in the language over time. The ninth part of the paper discusses the importance of the study of the history of the English language. It is a branch of linguistics which deals with the changes in the language over time. The tenth part of the paper discusses the importance of the study of the history of the English language. It is a branch of linguistics which deals with the changes in the language over time.

VI. PHASE II - THE MULTI-USER SYSTEM

A. INTRODUCTION

The decision to proceed with the development of a multi-user system was driven by the program manager's desire to involve both the MTF and individual officer more closely in the EME educational process. While multi-user systems are generally more expensive and complex to implement than single-user systems, the benefits derived from increased productivity and reduced transaction costs can far outweigh the initial cost. There are four possible methods for supporting a multi-user database system: teleprocessing, client server computing, resource sharing, and distributed systems.

Teleprocessing is a classic legacy implementation. With teleprocessing all communications control, operating system functions, applications, and DBMS components reside on a centralized computer. The processing is completed on the centralized central processing unit (CPU) and information is displayed on remotely connected dumb terminals. The user interface is often character-based and extremely primitive by today's standards. [Ref. 9, p. 507]

Client server computing consists of a network of computers connected over either a local area or wide area network. Local user machines are referred to as clients and "back-end" machines are called servers. In the database context, clients run application programs and servers store, manage, and process data. The server performs data integrity checking, concurrent access controls to records, and maintains the overhead data. A client server system tends to place the application closer to the end-user resulting in better performance and more sophisticated user interfaces. [Ref. 9, p. 507]

Resource sharing systems also involve networked computers. The primary difference between resource sharing and client server systems is in the services provided by the "back-end" server. In the resource sharing environment, the server usually provides fewer services, requiring instead that more information be passed between

processors. Resource sharing systems traditionally require more bandwidth and have decreased throughput when compared to the other alternatives. [Ref. 9, p. 507]

Distributed systems are implemented in two ways: distributed processing and distributed data. Distributed processing is the ability for more than one interconnected processor to be operating at a time. This means processing an application on more than one computer at a time. Distributing data is dividing the database and distributing portions throughout the system. Both approaches present significant problems for synchronizing data over a widely distributed system. The use of distributed database technology also requires developing system-wide rules to govern communication between nodes, data accessibility, program and file transfers, and common operating procedures. These factors usually mean increased cost over the other feasible alternatives. [Ref. 14, pp. 147-148]

The client server model offers a multi-user solution which best fits the existing organizational structure and meets the program manager's requirements. Because the prototype system was developed as a relational database it can be easily migrated to the client server model. Client server databases ensure excellent data integrity by enforcing stringent concurrent access rules. Client server systems are also easily scaleable from local area to wide area networks. Network traffic is less in client server systems than in resource sharing which is a significant concern with the small amount of available bandwidth in most wide area networks. Moreover, the client server model is not as complex as distributed systems and reduces the inherent synchronization problems.

This chapter analyzes and defines the requirements for the multi-user system based on the client server model. Coding of the multi-user application will be accomplished by programmers at DMDC West based on the prototype system design and information provided in this chapter. DMDC has considerable experience in developing DOD client server applications and will provide assistance throughout the systems development process under a partnership agreement with the EME program.

B. ANALYSIS PHASE

The SDLC is an iterative process whereby phases are re-visited as the environment changes and the deployment of a system proceeds. This section examines issues pertinent to the development of the multi-user system.

The EMETRAK multi-user system will be a transaction-based processing application consisting of two parts: a Windows-based client distributed to Navy MTFs and a central database server. Connectivity between the client applications and database server will be accomplished over the existing Navy-wide medical network or via commercial switched networks (Figure 22).

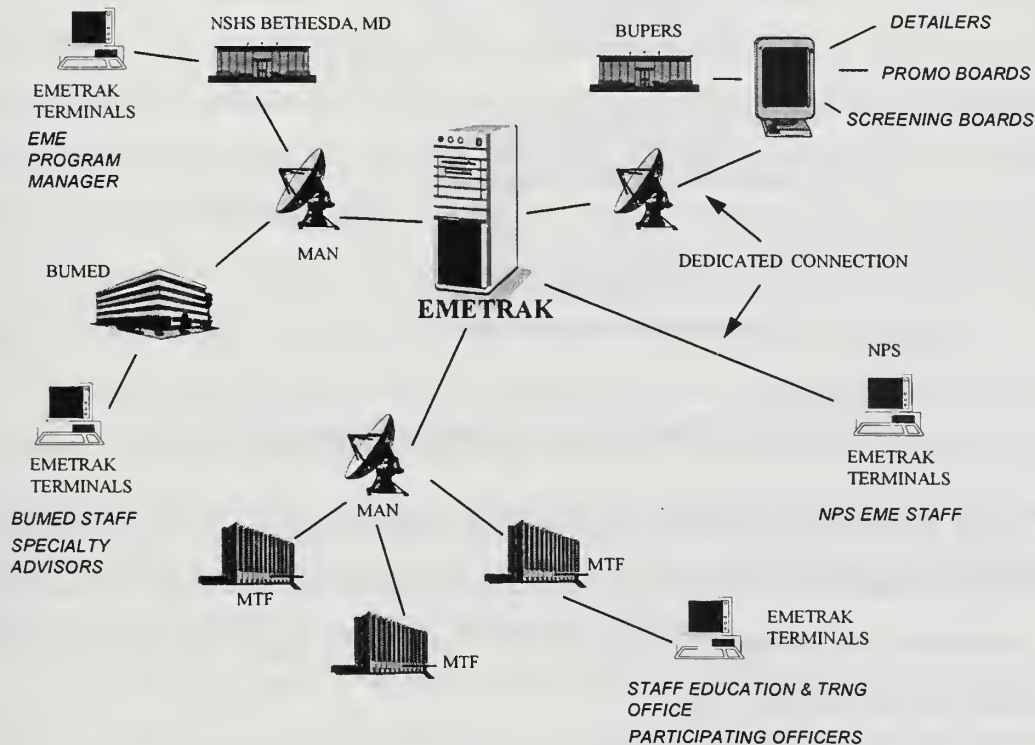


Figure 22. Logical Client Server Topology

In a transaction processing system, transactions consist of a query string sent by the client and a data set returned by the server. Figure 23 illustrates the general sequence of events in a client server system when an end-user accesses the database server over the network.

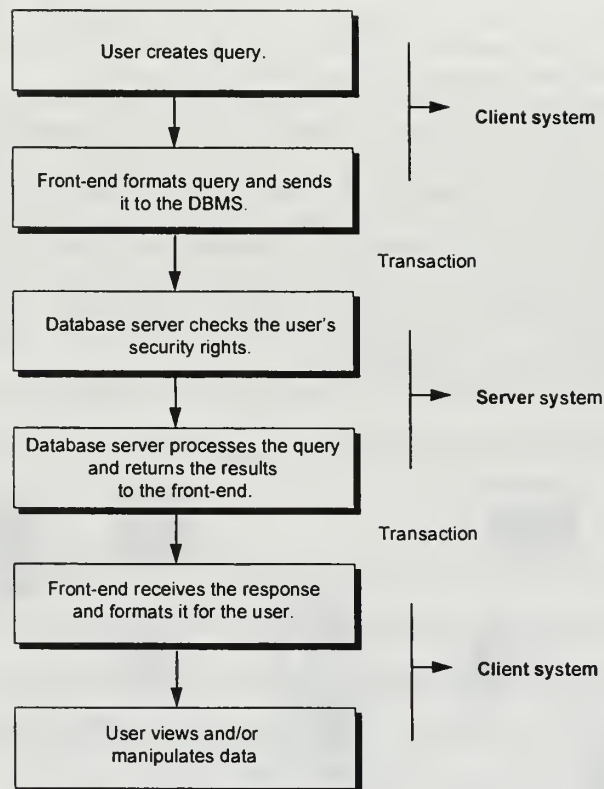


Figure 23. Client Server Transaction Sequence [Ref. 11]

If a transaction processing application is properly designed, the fact that the data is remotely located on a server will be transparent to the user. However, this requires that the application be optimized to reduce the bandwidth requirements and hence the response time over the network.

Responsiveness of transaction processing systems is affected by several factors including: transaction size, transaction rate, concurrent network traffic, and the capacity of the network connection. Transaction size can be thought of as the physical length of the query string and the size of the data set that is returned. The transaction rate is the number of requests processed by the system in a specified time period. Concurrent network traffic is the volume of data on the network with which the transaction must

compete. The capacity of a network connection usually ranges from 9600 bits per second (modem connection) through several gigabits per second for advanced optical networks. The current NMDN capacity through DISN is only 56 kbps.

An application's bandwidth requirements are of much greater concern over a WAN because the available bandwidth is usually much smaller (almost 10 times smaller) than local area networks. Bandwidth concerns lead to an analysis of the existing prototype for transaction size and the NMDN for traffic volume.

1. Prototype Peer to Peer Test

Testing was conducted on the prototype system to determine an approximate transaction size and system response time. It has to be noted that the prototype system was not designed to operate over a network; therefore, it was not optimized for the peer-to-peer network configuration in which it was tested. However, the test was adequate to provide some initial planning data. The test revealed that the average transaction size of the prototype was quite large at approximately 50 kilobits (kb). Transactions of this size resulted in slow response time over a 14,400 modem direct dial-up connection.

It was assumed that users would be willing to endure a substantial wait (as long as one minute) on initial start-up to download the data set to their local machines, but would then expect almost immediate response when toggling through records. The test proved that the transaction size in the multi-user system must be considerably smaller than 50 kb to achieve acceptable response after initial start-up delays.

While unable to exactly determine the transaction rate for the EMETRAK multi-user system at this stage, it is anticipated to be low based on the nature of the application and the expected number of simultaneous users (16).

2. Current NMDN Usage

Bandwidth usage was examined over several of the existing NMDN wide area connections. NMIMC used HP OpenView® network monitoring software to collect the data from three sites over a five day period and provided the information at the request of the EME program office. Table 6 is a summary of the findings.

Circuit	Capacity	Day	Time		
			0900	1200	1500
			units	kilobits/sec	(kbps)
BUMED	1.54 Mbps	1	14	5	5
		2	17	4	7
		3	12	5	11
		4	18	3	5
		5	14	9	6
	AVG		15	5.2	6.8
NSHS Bethesda	56 kbps	1	4	1	2
		2	3	5	1
		3	4	5	4
		4	Down	3	1
		5	2	1	2
	AVG		3.25	3	2
NH Naples	256 kbps	1	17	15	13
		2	19	14	13
		3	11	17	16
		4	Down	Down	Down
		5	14	15	14
	AVG		15.25	15.25	14

Table 6. NMDN Network Traffic Summary

Although more extensive monitoring is required, it is assumed that the data is representative of normal network traffic volume. The initial investigation shows that the NMDN has excess capacity to support the EMETRAK multi-user application unless network traffic increases significantly.

3. Proposed Changes in Bandwidth

NMIMC recognizes that the current 56 kbps connections will not support planned future applications such as multi-media telemedicine and is planning to increase the capacity during the next several fiscal years. Table 7 shows the planned NMDN DISN upgrades.

Activity	State	Current Capacity	Planned Upgrade
NH Bremerton	WA	56 kbps	512 kbps
NH Oak Harbor	WA	56 kbps	256 kbps
NH Lemoore	CA	56 kbps	256 kbps
NH Camp Pendleton	CA	56 kbps	512 kbps
NMC San Diego	CA	56 kbps	512 kbps
NH Corpus Christi	TX	56 kbps	256 kbps
NH Pensacola	FL	56 kbps	512 kbps
NH Millington	TN	56 kbps	256 kbps
NH Camp Lejeune	NC	56 kbps	512 kbps
NMC Portsmouth	VA	56 kbps	512 kbps
NH Patuxent River	MD	56 kbps	256 kbps
NNMC Bethesda	MD	56 kbps	512 kbps
NH Groton	CN	56 kbps	512 kbps
NH Great Lakes	IL	56 kbps	512 kbps

Table 7. NMDN DISN Planned Bandwidth Increases

The multi-user application will benefit from the planned increase in WAN capacity, however, it must still be designed to operate within the current bandwidth limitations. Moreover, not every MAN is scheduled to receive an increase in capacity.

C. DEFINITION PHASE

This section specifies the multi-user application requirements that will be delivered to DMDC West for design and implementation. The process and data models for the single-user system are also valid for the multi-user application and will be referenced in this section as well.

1. Connection Methods

EMETRAK requires two connection means from the client front-end application to the database residing on the back-end server. The primary connection protocol desired for the application is transmission control protocol/internet protocol (TCP/IP) through the existing NMDN via DISN or the Internet. An alternate method to ensure redundancy should be implemented through a dial-up connection using a standard modem and point to point protocol (PPP).

2. Database Views

Different views of the database are required in the multi-user application. Three views of the data are envisioned: program management, enterprise, and organizational views. The views correspond roughly to three user groups: the EME program management staff, top level Navy Medical Department executives, and the individual MTFs. Each view should be based on a set of user permissions programmed into the client application and enforced by the database server.

The views are unique, but are not necessarily mutually exclusive. For example, the program management staff would have privileges to access all views and to manipulate the database (except for those specifically reserved system administrator functions). Access to a database view should be determined through a combination of the user's UIC and password during system log on.

- Program Management view - The program management view of the database would allow the user to see all tables, queries, forms, and reports in the application. The program management view would be available to the EME program management staff at NPS, the program manager at NSHS, Bethesda, and the EME system administrator (with additional functions provided).

- Enterprise view - The enterprise view is envisioned as an executive level view. The enterprise view would provide screen reports about the program derived from statistical summaries. The enterprise view would allow the user to “drill” down and see officers filtered by their designator number or see information about an individual officer, if desired. The enterprise view would be available to the Surgeon General, the Medical Department Corps Chiefs, and other selected executives at BUMED, BUPERS, and NSHS, Bethesda, MD.
- Organizational view - The organizational view would center on the officers assigned to a specific command (UIC). The organization would be able to view all information that pertains to officers in the command or within a specific designator group subject to a filter. Consequently, the OFFICER and CLASS table views, system queries, and reports should be based on the appropriate filter and the user’s password. All UIC, COURSE, and COMPETENCYCAT tables, however, could be viewed in the organizational view. The organizational view would be available to all MTFs and BUMED specialty advisors. MTFs would view information filtered by UIC and specialty advisors view by the appropriate designator number.

Access to the database views should be controlled through a user interface described by the state transition diagram in Appendix J.

3. User Functions and Responsibilities

This section specifies who may perform certain functions in the multi-user system.

a. Data Maintenance Function (Figure 7)

- **Update Officer Information (Process 1.1)**
 - Add Officer - BUPERS and EME Staff
 - Modify Officer Information - BUPERS, EME Staff, and MTF
 - Delete Officer - EME Staff
 - Change Officer Location - BUPERS
- **Update Course Information (Process 1.2)**
 - Add Course - EME Staff (System Administrator)
 - Modify Course Information - EME Staff (System Administrator)
 - Assign Course to Competency - EME Staff (System Administrator)
- **Update Command Information (Process 1.3)**
 - Add Command - EME Staff (System Administrator)
 - Modify Command Information - MTF and EME Staff (System Administrator)
 - Delete Command - EME Staff (System Administrator)
- **Generate Class Information (Process 1.4)**
 - Add Class - MTF and EME Staff
 - Modify Class Information - MTF and EME Staff
 - Delete Class - EME Staff (System Administrator)
- **Import/Export Information (Process 1.5)**
 - Create Backup and Archive (Process 1.5.1) - EME Staff (System Administrator)
 - Export data to dbIII file format (Process 1.5.2) - All users

- Import BUPERS OFFICER data file (Process 1.5.3) - EME Staff
(System Administrator)

4. Required Queries

The queries listed in this section are organized according to the EMETRAK process model (Figure 8). They are further grouped according to the database views that apply. Queries (structured or interactive) may be combined during implementation to support various screen and hard copy report formats as required. Implementation of an interactive menu of queries and reports similar to the “SelectaRun” form in the prototype application is desired.

a. Run Structured Queries (Process 2.1)

(1) Generic queries

- All course modules
- All course modules grouped by course sponsor
- All course modules grouped by competency category
- All competency categories
- All command information (UIC number, name, address, etc.)
- All course modules delivered in the last 90 days and their locations

(2) Queries common to the program management and enterprise views

- All officers in alphabetical order
- All officers in alpha order grouped by command (UIC)

- All officers in alpha order and completed modules grouped by command (UIC)
- All officers in alpha order and completed modules
- All officers in alphabetical order grouped by designator
- All officers in a command (UIC) grouped by designator
- All officers in alpha order in a command and completed modules grouped by designator

(3) Queries common to the program management and organizational views

- All classes delivered in the last 90 days

b. Generate Interactive Queries (Process 2.2)

(1) Generic queries

- All course modules grouped by course sponsor (select on course sponsor input)
- All course modules grouped by competency (select on competency input)

(2) Queries common to the program management and enterprise views

- All officers in alpha order (select on UIC input)

- All officers in alpha order and completed modules (select on UIC input)
- All course modules completed by a specific officer (select on SSN input)
- All officers based on profile query requiring one or more of the following input:
 - Rank
 - Service
 - Designator
 - UIC
 - Health Service Region
 - Course Module (or range of modules)

(3) Queries common to the organizational view (filter by UIC

Number)

- Officers in alpha order (select on designator input)
- Officers in alpha order (select on rank input)
- Officers in alpha order (select on course module or competency category input)

c. *Generate Statistical Reports (Process 2.3)*

(1) Generic queries

- The average number of EME hours attained per officer
by: total officers, rank, designator, UIC, and HSR
- The number of officers that have completed a specific course
(grouped by course)

by: total officers, rank, designator, UIC, and HSR

- The number of officers that have completed a competency category (grouped by category)

by: total officers, rank, designator, UIC, and HSR

- The percentage of officers that have completed a specific course (grouped by course)

by: total officers, rank, designator, UIC, and HSR

- The percentage of officers that have completed a competency category (grouped by category)

by: total officers, rank, designator, UIC, and HSR

- The number of courses in the EME curriculum by course sponsor
- The number of hours provided, sub-divided by sponsor by: fiscal quarter, fiscal year, and between two dates

5. Required Reports

The reports listed in this section are organized according the EMETRAK process model (Figure 9). The report formats must conform to the style presented in the Appendix G. Structured, Interactive and Statistical reports are listed in Tables 8, 9, and 10, respectively. The abbreviations P, E, and O in the tables correspond to the program management, enterprise, and organizational views.

a. Generate Structured Reports (Process 3.1)

Structured reports are pre-formatted reports that do not require user input.

Number	Report Name	Views
1	Officers in Alphabetical Order	P, E, O
2	Officers in Alphabetical Order Grouped by Designator	P, E, O
3	Officers in Alphabetical Order Grouped by Command	P, E
4	Officers in Alphabetical Order and Completed Modules	P, E, O
5	Course Modules (with descriptions)	P, E, O
6	Competency Categories	P, E, O
7	Course Modules by Competency Category	P, E, O
8	Course Modules by Sponsor	P, E, O
9	Participating Commands (UIC)	P, E, O
10	Course Completion Letter	P, O
11	Completion Certificate	P, O
12	Official Transcript	P

Table 8. Structured Reports

b. Generate Interactive Reports (Process 3.2)

Interactive reports require user input to determine selection criteria for the data set in the report.

Number	Report Name	Views
13	Officers and Completed Modules Grouped by Designator (input designator)	P, E, O
14	Officers and Completed Modules Grouped by Command (input UIC)	P, E
15	Officers and Completed Modules Grouped by Rank (input rank)	P, E, O
16	Completed Modules by a Specific Officer (input SSN)	P, E, O

Table 9. Interactive Reports

c. Generate Statistical Reports (Process 3.3)

Statistical reports provide summaries of the data in tabular (T), line graph (L), bar (B), or pie chart (P) format. Appendix K provides examples of the statistical format types.

Number	Report Name	Views	Type
17	Course Modules Provided in Last 90 Days	P, E, O	T
18	Classes Provided in the Last 90 Days	P, E, O	T
19	Average EME hours attained per officer by: total officers, rank, designator, UIC, and HSR	P, E	T/L
20	Number of officers that have completed a specific course (grouped by course) by: total officers, rank, designator, UIC, and HSR	P, E	T
21	Number of officers that have completed a competency category (grouped by category) by: total officers, rank, designator, UIC, and HSR	P, E	T
22	Percentage of officers that have completed a specific course (grouped by course) by: total officers, rank, designator, UIC, and HSR	P, E	P
23	Percentage of officers that have completed a competency category (grouped by category) by: total officers, rank, designator, UIC, and HSR	P, E	P
24	Number of courses in the EME curriculum by course sponsor	P, E	B
25	Number of hours in the EME curriculum by course sponsor	P, E	B
26	Number of hours provided, sub-divided by sponsor by: fiscal quarter, fiscal year, and between two dates	P, E	T

Table 10. Statistical Reports

6. Security Requirements

National Telecommunications and Information Systems Security Publication 2 (1986) specifies that sensitive but unclassified information must be protected from disclosure, loss, misuse, alteration, or destruction. The EMETRAK database contains sensitive but unclassified information protected under the Privacy Act of 1974. Therefore, the EMETRAK system must comply with the security class C2 controlled access protection. [Ref. 13]

Access controls must be enforced at both the client and database server level. Information security should be enforced through the following mechanisms:

- Discretionary access control - Define and control access between named users and named objects (files, tables, forms, reports, etc.) down to the single user

level in the system. The enforcement mechanism should be through the use of group and user permissions.

- Identification and authentication - Use a protected mechanism (log on and passwords) to authenticate a user's identity. The log on procedure should be implemented in the client application. Authentication data must be protected from access by unauthorized users and should be implemented in the server application.
- Data security - The system must be able to encrypt the officer SSN, last name, and UIC prior to transmission. This feature prevents name, SSN, and UIC association during data transmission between the client site and the server.
- Audit - The system must have a transaction tracking capability to audit modifications, insertions, and deletions from the database. Identification of the time, date, user ID, and type of transaction accomplished is required.

7. Client Application Features

The client must be a Windows-based application that is capable of running on the Windows® 3.11 operating system using a 80386 or later version processor with 8 MB of RAM. The intention is to distribute run-time executable versions of the EMETRAK client via floppy disk, file transfer protocol, or electronic mail. Therefore, the client must contain its own set-up utility.

The client user interface should emulate the prototype application and support a local query and report generation capability. The application must support ANSI SQL 89 and the Open Database Connectivity (ODBC) protocol. Finally, an identification and authentication feature must be incorporated in a log on routine.

8. Database Server Application Features

Selection of the server hardware and operating system will be based on the system requirements of the database server application. Specific procurement recommendations for a server and operating system are beyond the scope of this thesis and will not be addressed. However, a server database application should have the following features:

- Support client server computing over a wide area network using TCP/IP
- Must be C2 compliant
- Allow 16 simultaneous users
- Provide fine-grained database privileges for objects, queries, and access
- Provide concurrency control through row (record) level locking
- Provide for centralized security management
- Provide an adjustable auditing capability
- Support stored procedures activated by client application remote procedure calls
- Provide parallel query support
- Provide on-line back-up capability
- Support job scheduling for reports and back-ups

D. RECOMMENDATIONS FOR THE REMAINING SDLC PHASES

The remaining stages of development for the multi-user system are design, coding, testing, implementation, and support. DMDC programmers will begin design and coding once the requirements are completed. They estimate that eight weeks will be required to produce an initial version of the multi-user system. Once the system is

functional, it will undergo extensive system testing to verify and validate the requirements.

1. System Testing

System testing will be accomplished in two stages: alpha and beta testing. Alpha testing involves reviewing the basic functionality of the system over both types of connection methods: TCP/IP (Internet) and PPP (dial-up). DMDC will provide a functional client application to the EME staff and the EMETRAK development team for testing. Data will be migrated from the single user system to an Oracle Server 7.2 RDBMS running on a Sparc 20 workstation located at DMDC West. DMDC has agreed to maintain the database during the entire testing period estimated to last approximately six months. Five test nodes are recommended for the alpha test; four at NPS and one at NSHS, Bethesda. The test nodes are the EME program coordinator, EME administrative support staff (2 nodes), EME program manager at NSHS, and the EMETRAK development team. Special attention must be focused on evaluating system response over the wide area connection during the alpha test. Recommended improvements from the alpha test version should be incorporated prior to the beta test stage.

Beta testing should involve a limited number of MTF sites to further test system functionality over the existing NMDN architecture. During the beta test stage, a decision regarding the procurement of server hardware, software, and location will be required. Further, system support decisions will be required concerning database/system administration and technical support personnel at that stage. Two goals of the beta test should be to migrate the existing database from DMDC to an EMETRAK server and to have an adequate technical support structure in place before beginning system installation.

2. System Installation

Two options are provided for installation. One option is the procurement of a dedicated EMETRAK server and another is outsourcing server support to a DOD organization.

The dedicated server option requires a substantial capital expenditure which has been planned and budgeted. The advantage offered seems to be increased management control because the EME program office is taking ownership of the administration process. The disadvantage of owning a dedicated server is the major increase in maintenance and personnel costs over the single-user system. Training cost for a database/systems administrator is another factor in selecting an installation option. DMDC database administrators estimate that approximately four months of training are needed on Oracle or comparable RDBMS systems to adequately prepare a person for the database administrator position. Training for the server operating system and system administration is also required. Developing and maintaining expertise in these areas will require a significant investment of time and money.

An alternative that should be investigated is migrating the database from DMDC to the NPS Oracle 7.3 DBMS running on the University's Digital Equipment Corporation (DEC) Alpha server. An agreement could be arranged whereby the EME program reimburses NPS for data storage, computing support, and technical support services for the back-end server. Outsourcing for service is advantageous because the day-to-day data and system administration is shifted from the program office to the service provider. Although further study is required, this option seems to offer a cost effective alternative to procuring and maintaining a dedicated server.

VII. SUMMARY

A. PROJECT CONCLUSIONS

1. Service-based Learning

Service-based learning is a form of job instruction training where learning and experience are gained while providing a service [Ref. 14, pp. 252-253]. It is not as narrowly focused or closely supervised as on-the-job-training, but it enables a person to thoroughly explore a subject area and then apply what has been learned to a project. The EME program provided just such an opportunity.

The EMETRAK project facilitated my development as a systems analyst by providing an opportunity to learn about design and implementation issues during the actual deployment of a system. Service-based learning is not appropriate in every situation, particularly when a project is under tight schedule or budget constraints. However, in the academic environment, service-based learning proves to be a practical way to provide experience for students learning the role of a systems analyst.

This topic was ideal for providing systems analysis experience because of its scope and the fact that each stage of the SDLC was explored. It provided design as well as project management experience and required knowledge of many different technologies. The project required study of process and data modeling techniques, database, application and network design. Further, it enabled the application of analysis techniques and project management tools learned in the Information Technology Management curriculum to a real world example. Finally, the project required interaction with program managers, the system owner, end-users, and programmers to successfully develop an application that met the requirements of the Navy Medical Department.

2. The Prototype System as a Development Tool

Prototypes are developed by programmers to solicit feedback and assist in application and interface design. The Phase I prototype system served this purpose, but it was also used as a model for Phase II. Once the prototype application was refined, it became the vehicle for describing system requirements for programmers developing the multi-user version. Programmers studied the written specifications and then referred to the prototype to see the desired functionality.

The use of a prototype greatly streamlined the development process for both phases of EMETRAK. Access 2.0® was an excellent prototyping and rapid application development tool. Speed of development was extremely important in order to meet the initial project milestones. However, the prototype application proved to be even more effective when used by the analyst to describe multi-user system requirements.

3. System Owner and End-user Involvement

This project reinforced the importance of managerial support and end-user involvement to the success of a systems development effort. The ability to articulate the benefits of the system and demonstrate a functional prototype after only a few weeks of programming helped garner crucial political and economic support for the project at a time when formal approval and project funding were in doubt. Moreover, proving that the project was feasible established our credibility with the system owner which was critical to sustaining development over the life of the project.

Involving end-users early in development helped avoid potential problem areas and allowed more detailed system specifications to be written. The detailed nature of the specifications reduced the number of changes and resulting delays during implementation. Further, end-user acceptance was enhanced because they were able to gain first-hand experience with the application and see the benefits as the system was being developed.

Management and end-user support was enhanced in this project because each was closely involved in the process and became partners in system development.

4. Changing Scope of the Project

One of the original research questions asked what type of information system would support the future needs of the EME program; a single user system, a multi-user system implemented over a LAN or a multi-user system implemented over a WAN? The answer really is all three. In the early stages of the project (FY-95), a single user system was adequate to meet the requirements for data collection and reporting for a limited number of participants. As the scope of the EME program increased in FY-96, the supporting staff grew and the number of end-users increased. A multi-user system implemented over a LAN at NPS proved adequate to support administration of the program. Remote access to the database from numerous end-user sites is still the desire for FY-97. While the exact deployment schedule of the multi-user system is in question, it will eventually be implemented over a wide area.

The point is that the scope of any project will change and must be planned for during development. In the case of EMETRAK, the fundamental process and data models were designed to be scaleable. During implementation, the selection of the client server model permitted the multi-user system to be implemented over either a LAN or WAN as the number of end-users and their locations changed.

The key to success seems to be understanding that the scope of a project will change and then anticipating how the system will be affected by the change. This was achieved in the EME project through a thorough analysis of the business problem and, most importantly, by having a vision and the support of the program manager and system owner.

B. AREAS FOR FURTHER RESEARCH

1. Multi-user System Installation and Support Issues

A significant number of EMETRAK life cycle management issues require further study. Alpha and Beta testing must be concluded and the multi-user system must still be installed and supported in the field. Installation issues which require further analysis are selection of the database server, NMDN network bandwidth usage, determining the EMETRAK deployment schedule, and development of a technical support infrastructure. System and code maintenance, client application version control, database maintenance, and analysis of future system requirements are system support issues that should be investigated.

2. EMETRAK Integration Issues

EMETRAK currently has a fairly narrow focus, however, its relational architecture makes it well suited to handle other types of data pertinent to the individual officer. The system is capable of tracking educational information from sources outside of the EME program, medical readiness data, or professional credentials of the Medical Department officer. Incorporating this type of information into a central repository warrants further study.

Integration of EMETRAK data with other applications like the Reserve Training and Readiness System (RSTARS), the Navy Integrated Training and Assignment System (NITRAS Phase II), or the DOD integrated personnel system also have merit and provide areas for continued research.

3. Application of World-Wide Web (WWW) Technologies

The recent explosion of Web technologies provides another avenue for delivering EME information to the customer. Programming languages like Java allow the

development of self-contained EMETRAK-like applets that can be distributed over the Web. This technology is advertised as providing platform independence (hardware and software) and enables unlimited distribution of the application with minimal overhead. This type of technology offers an exciting alternative to traditional client server computing and will likely change our inter-networking paradigms in the future. Web technologies and security issues should be investigated as one possible future implementation of the program.

4. Distributed Database Technologies

Applications like Lotus Notes® have dramatically reduced the cost and complexity of managing distributed databases. Features that include concurrent access controls, automatic data replication, job scheduling, and fault tolerance have made it popular with organizations operating in the distributed computing environment. Moreover, the ability to integrate data directly into electronic mail, word processing documents, and other applications makes the system all the more appealing. This type of technology is being used by a number of other DOD agencies and its applicability to the EME program and Navy Medicine should be researched.

APPENDIX A. INITIAL USER QUESTIONNAIRE

This appendix contains the questions that were used during the initial interviews with the program manager and system owner to define the problem and limit its scope. The general categories were taken from Whitten. [Ref. 5]

I. About the PEOPLE

Who would be the end-users of this system?

Would anyone be indirectly affected by the system?

What existing system is in place (if any)?

What people or political problems, opportunities, or directives triggered this project request?

How will management and users feel about this project if it is approved for application development?

II. About the DATA

What are the key inputs to this system?

What are the key outputs from this system?

Is any data currently being captured and stored in computer files and/or databases?

III. About the ACTIVITIES

What is the purpose or mission of this business area (in non-computer terminology)?

What are the goals and objectives of this business area?

Has any of this system been computerized already?

IV. About the NETWORKS

Will this project provide support for multiple locations? If so, where are they?

How do the locations currently communicate?

Are any computer networks currently in use?

APPENDIX B. PROPOSED MTF DEPLOYMENT SITES

This appendix lists the proposed deployment sites for the EMETRAK multi-user system.

UIC	ACTIVITY	STATE
00162	NMCL ANNAPOLIS	MD
00267	NMCL KEY WEST	FL
48488	NMCL KINGS BAY	GA
46491	NMCL LONDON	UK
66898	NMCL NEW ORLEANS	LA
68098	NMCL PEARL HARBOR	HI
68101	NMCL PHILADELPHIA	PA
66099	NMCL PORT HUENEME	CA
00105	NMCL PORTSMOUTH	VA
00231	NMCL QUANTICO	VA
65575	NMCL SEATTLE	WA
68349	REDCOM 16 -MINNEAPOLIS	MN
61337	NH BEAUFORT	SC
00168	NNMC BETHESDA	MD
68095	NH BREMERTON	WA
68093	NH CAMP LEJEUNE	NC
68094	NH CAMP PENDLETON	CA
68084	NH CHARLESTON	SC
66094	NH CHERRY POINT	NC
00285	NH CORPUS CHRISTI	TX
00211	NH GREAT LAKES	IL
61726	NH GROTON	CT
68096	NH GUAM	MIC
61564	NH GUANTANAMO	CU
00232	NH JACKSONVILLE	FL
68875	NH KEFLAVIK	IC
66095	NH LEMOORE	CA
68090	NH LONG BEACH	CA
60002	NH MILLINGTON	TN
66096	NH NAPLES	IT
68086	NH NEWPORT	RI
66097	NH OAK HARBOR	WA

UIC	ACTIVITY	STATE
00619	NH OAKLAND	CA
68470	NH OKINAWA	JA
65492	NH ORLANDO	FL
66098	NH PATUXENT RIVER	MD
00203	NH PENSACOLA	FL
00183	NMC PORTSMOUTH	VA
65428	NH ROOSEVELT ROADS	PR
66101	NH ROTA	SP
00259	NMC SAN DIEGO	CA
39163	NH SIGONELLA	IT
35949	NH TWENTYNINE PALMS	CA
68292	NH YOKOSUKA	JA
0608A	NNDC BETHESDA	MD
68443	NDC BREMERTON	WA
68410	NDC CAMP LEJEUNE	NC
62594	NDC CAMP PENDLETON	CA
65999	NDC CHARLESTON	SC
68326	NDC GREAT LAKES	IL
62328	NDC GUAM	MI
68444	NDC JACKSONVILLE	FL
62947	NDC LONG BEACH	CA
68442	NDC NAPLES	IT
66023	NDC NEWPORT	RI

APPENDIX C. EXISTING NMDN NETWORK TOPOLOGIES

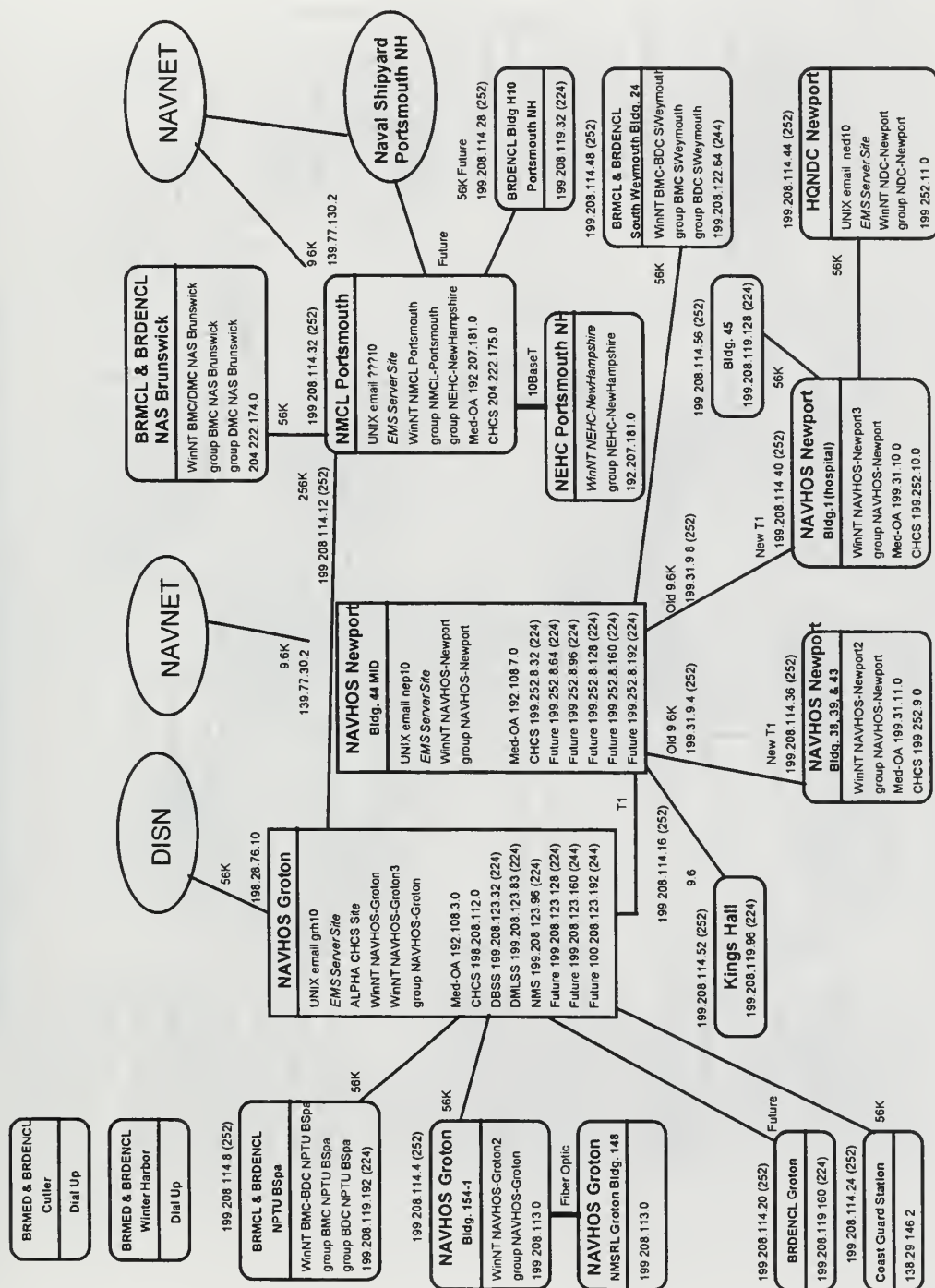


Figure C-1. North Atlantic Metropolitan Area Network (MAN)

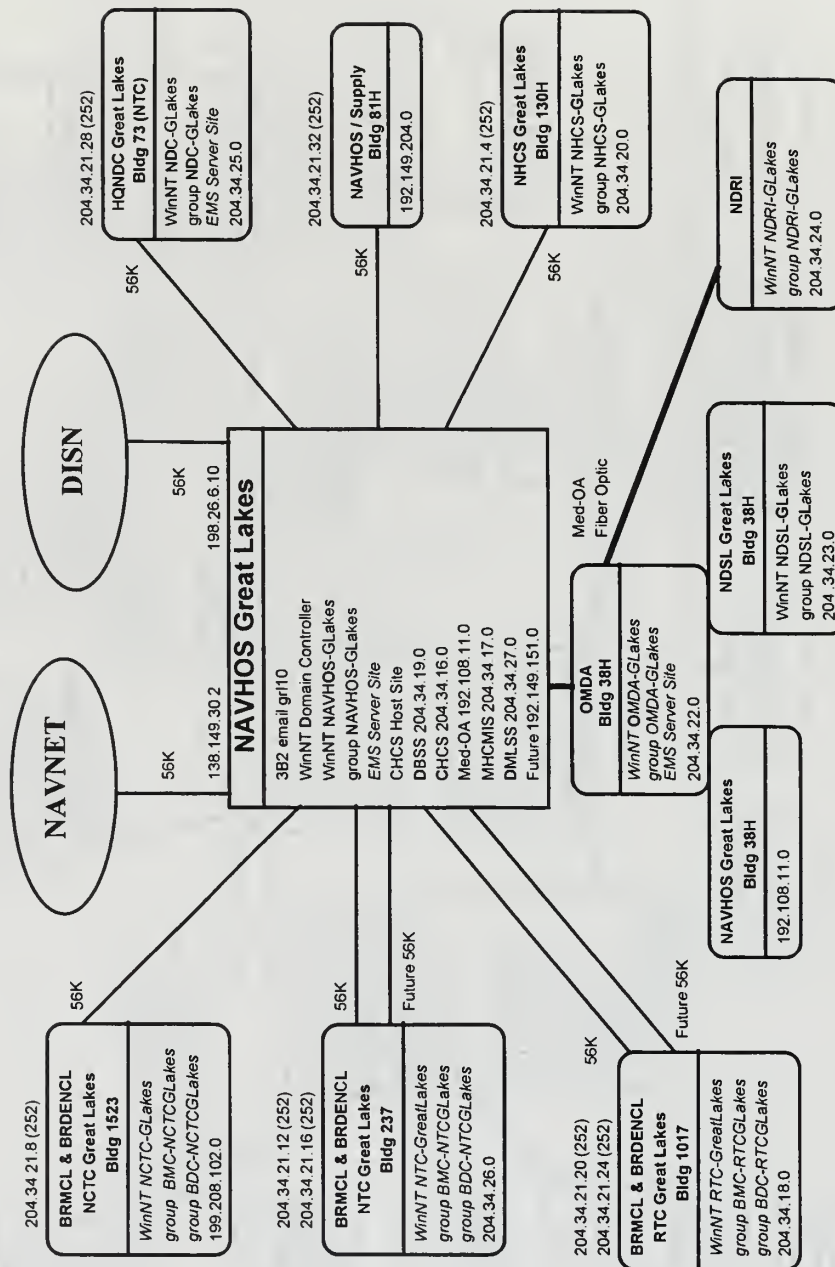


Figure C-2. Great Lakes Metropolitan Area Network (MAN)

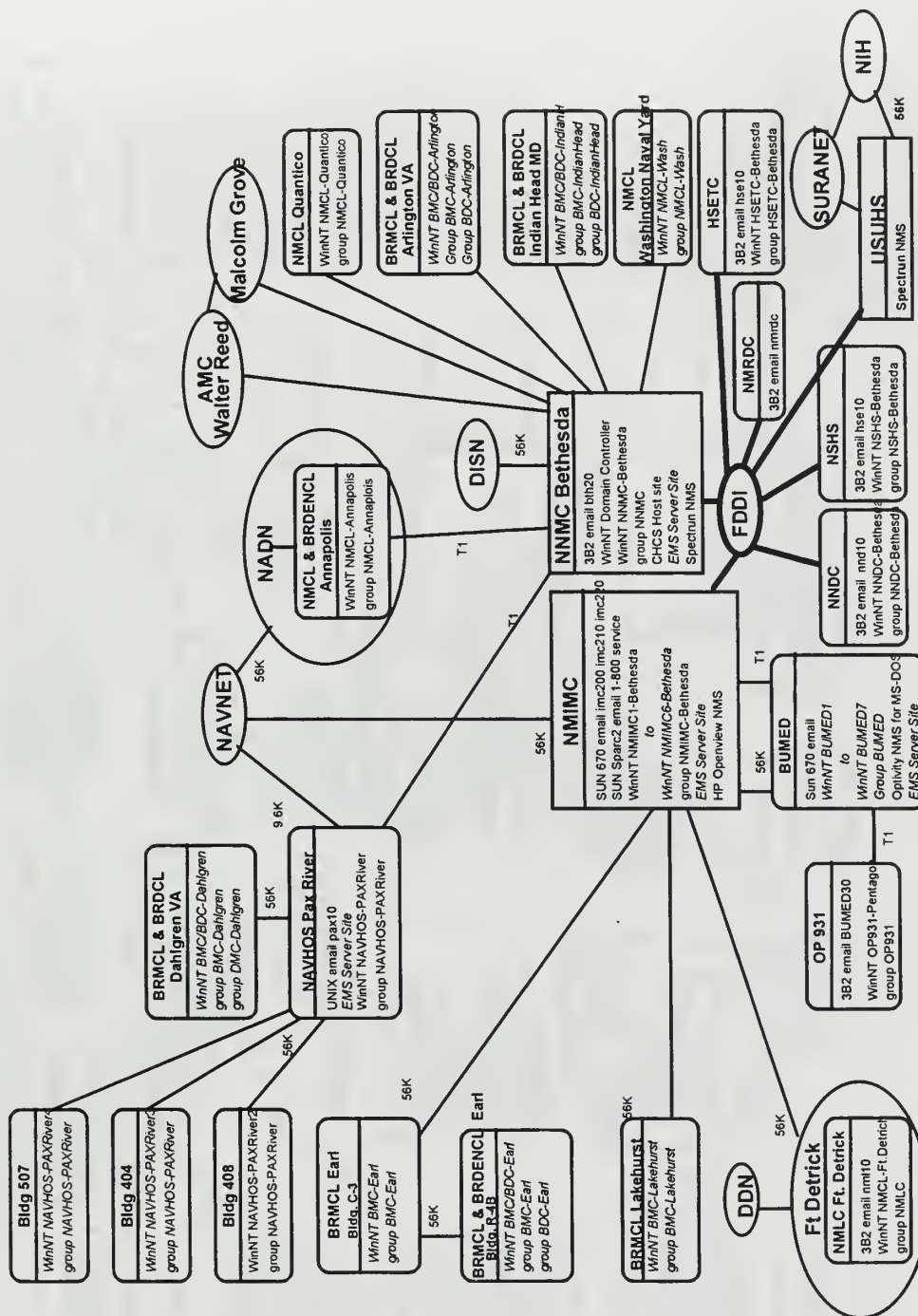


Figure C-3. Bethesda Metropolitan Area Network (MAN)

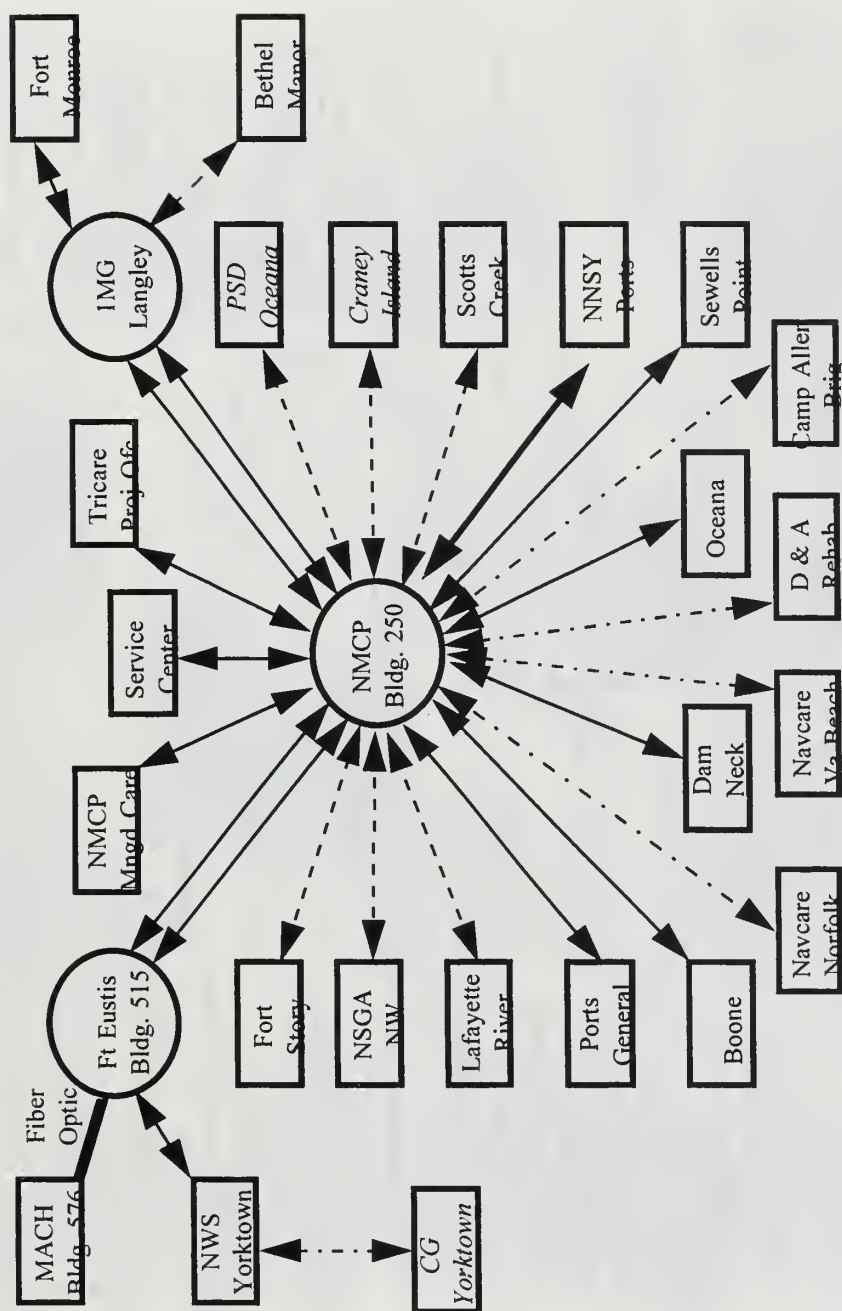


Figure C-5. Tidewater Metropolitan Area Network (MAN)

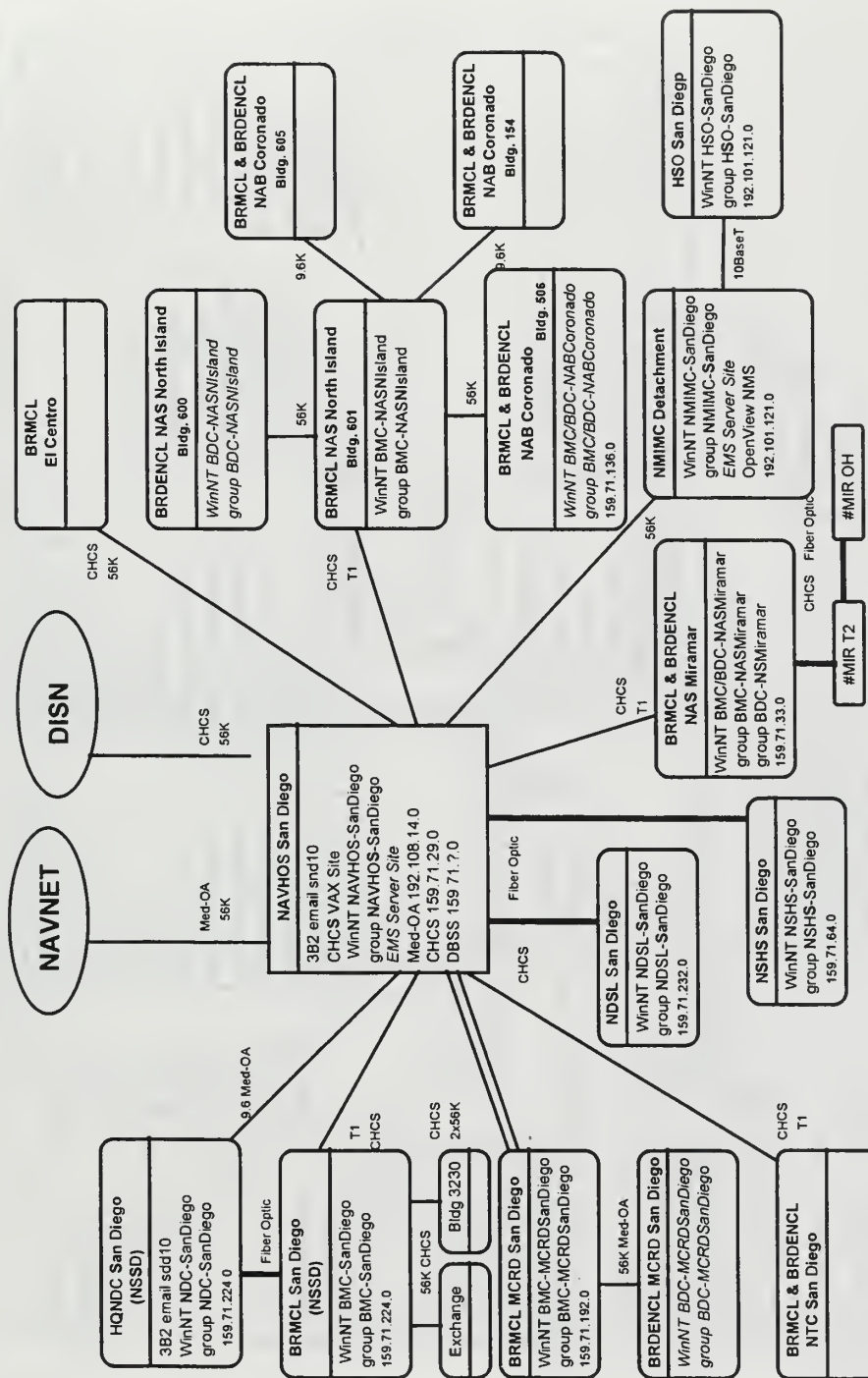


Figure C-9. San Diego Metropolitan Area Network (MAN)

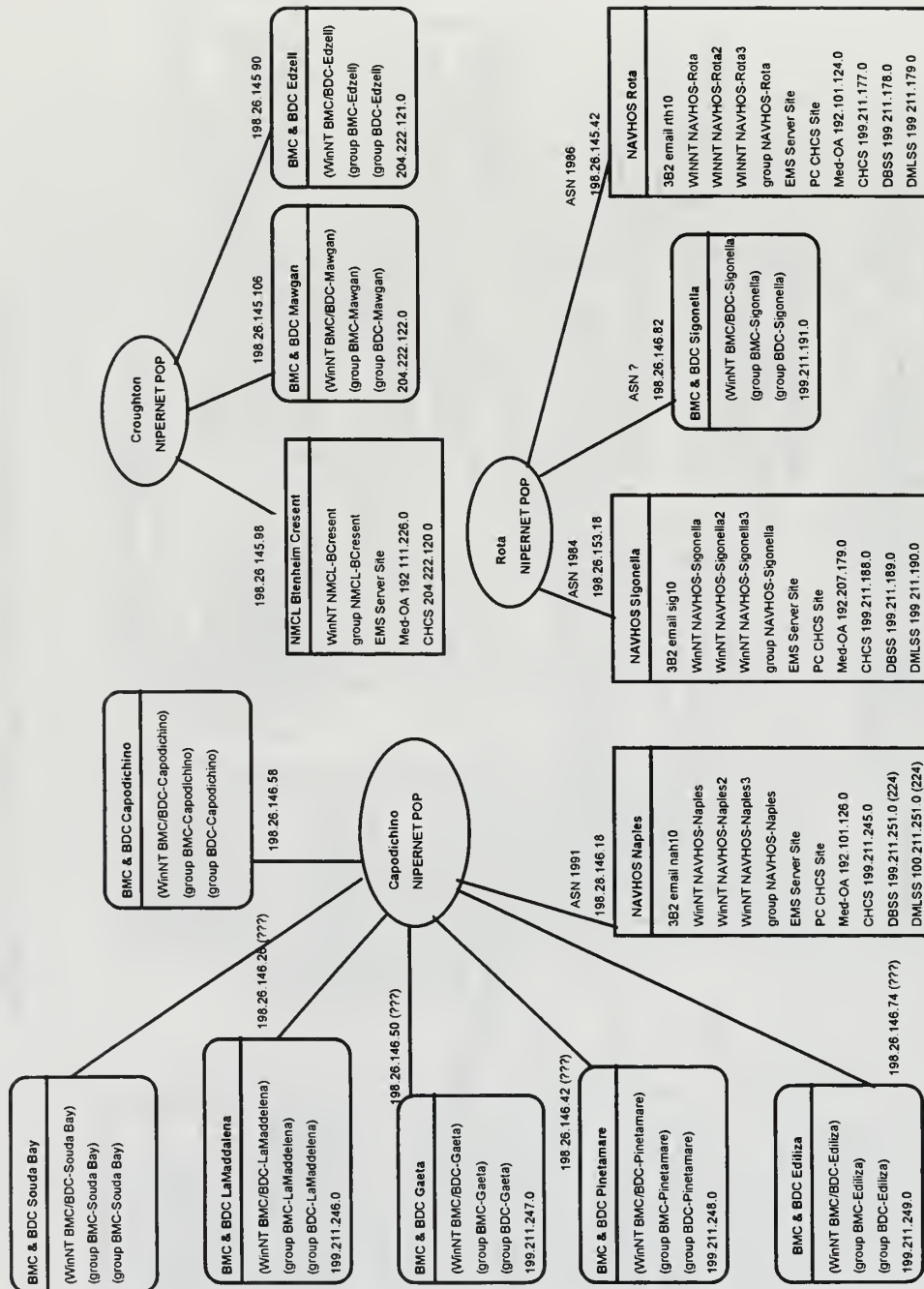


Figure C-10. Europe Metropolitan Area Network (MAN)

APPENDIX D. DATA FLOW DIAGRAMS

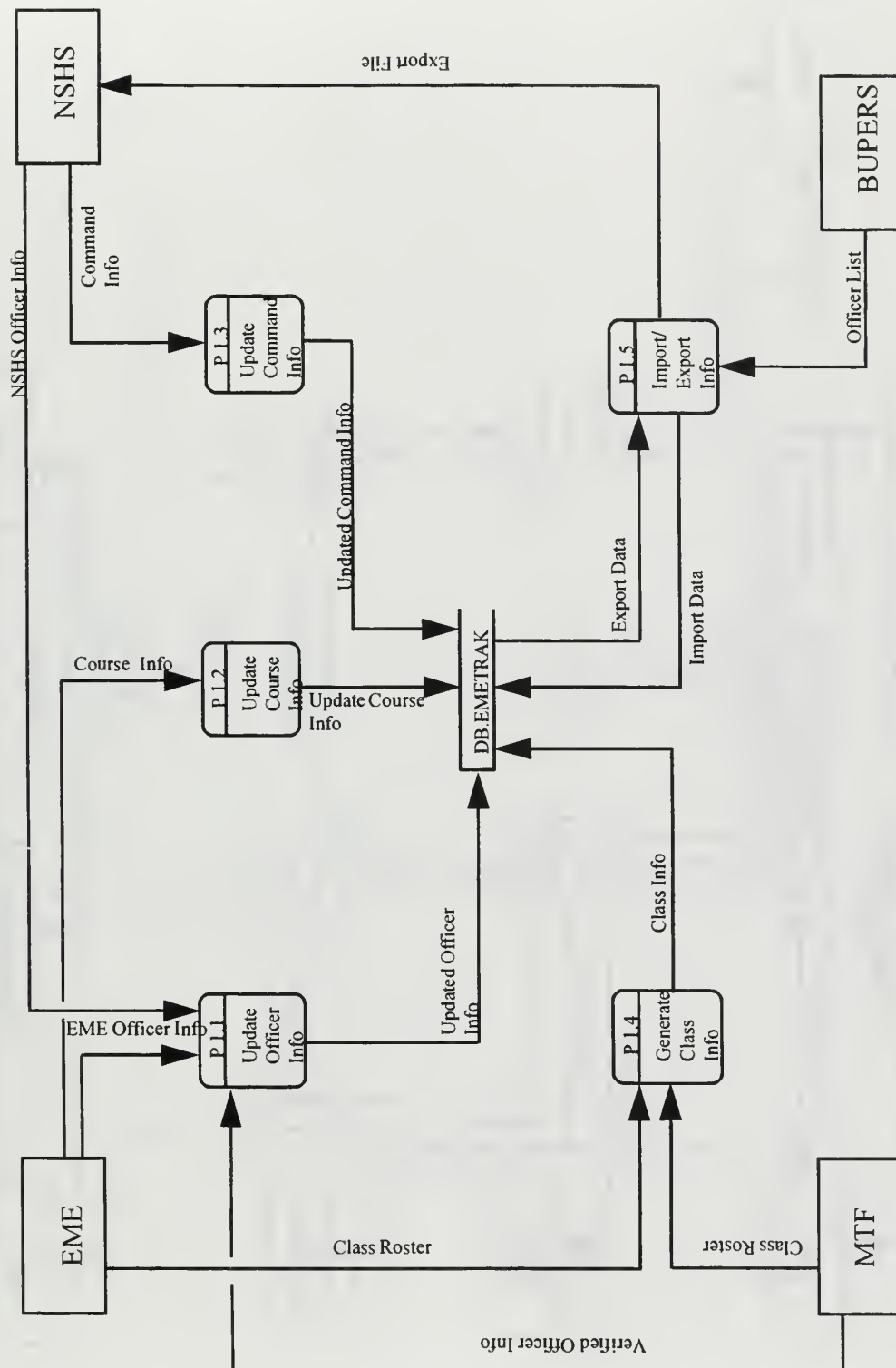


Figure D-1. Level 1 Process 1 Chart

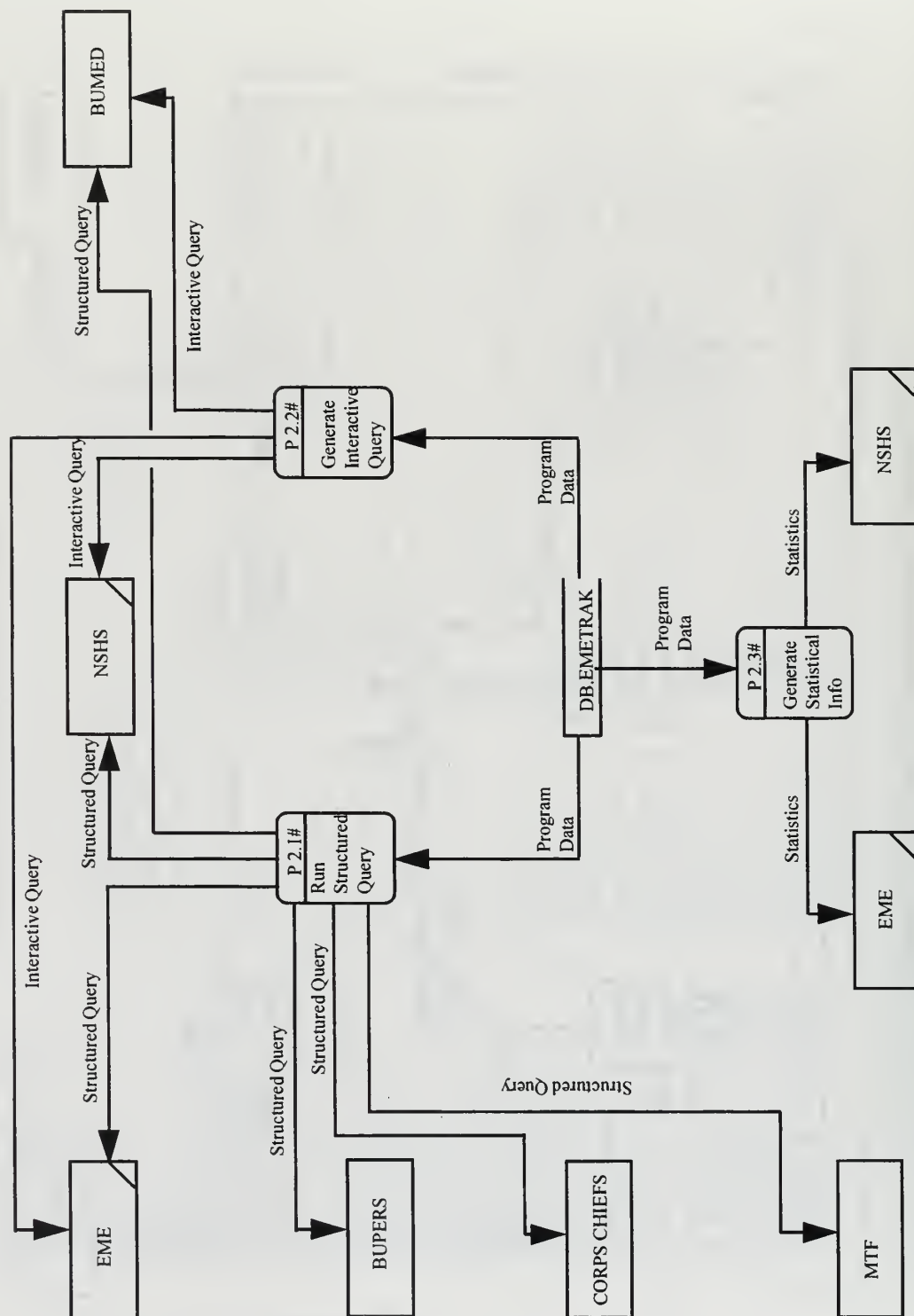


Figure D-2. Level 1 Process 2 Chart

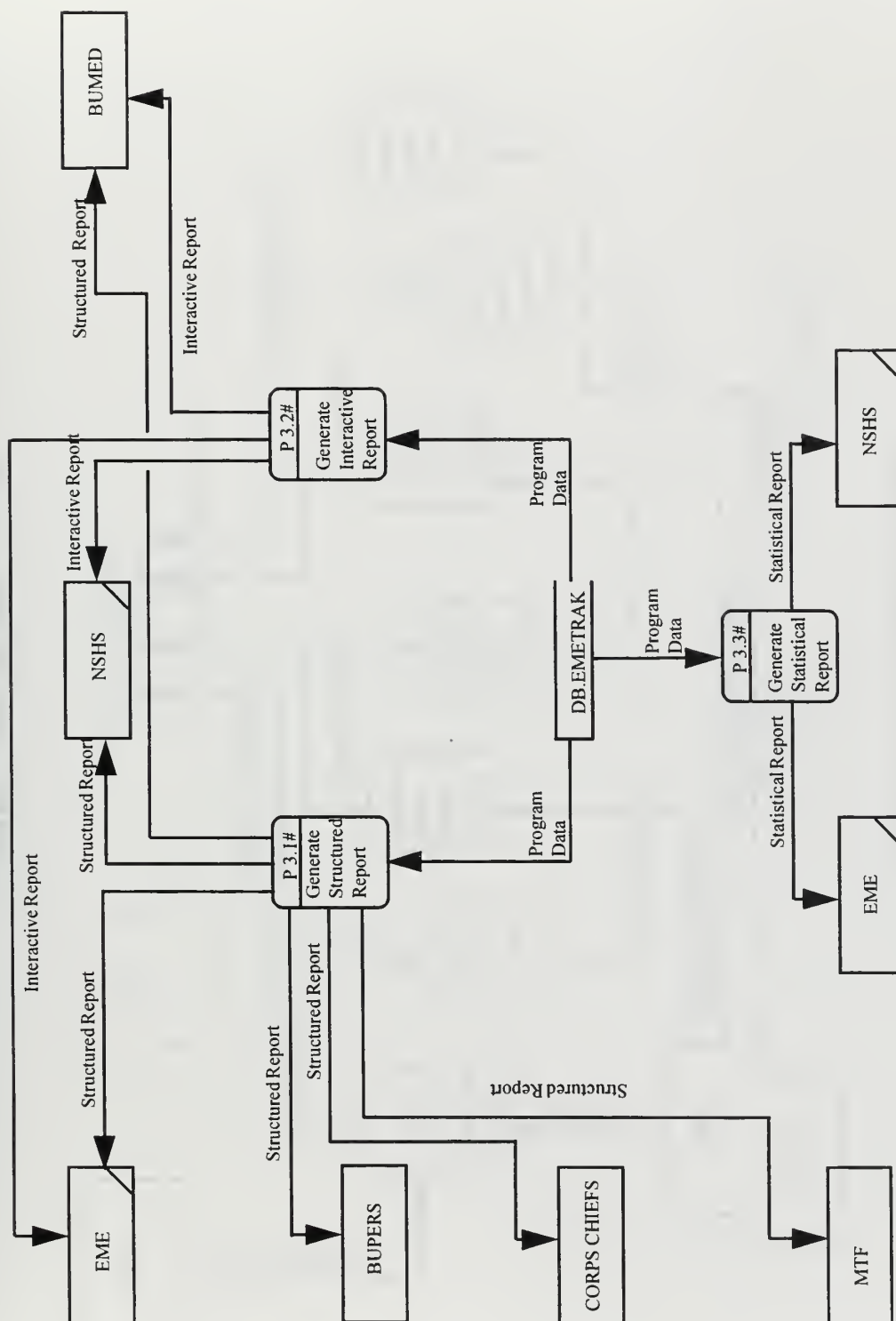


Figure D-3. Level 1 Process 3 Chart

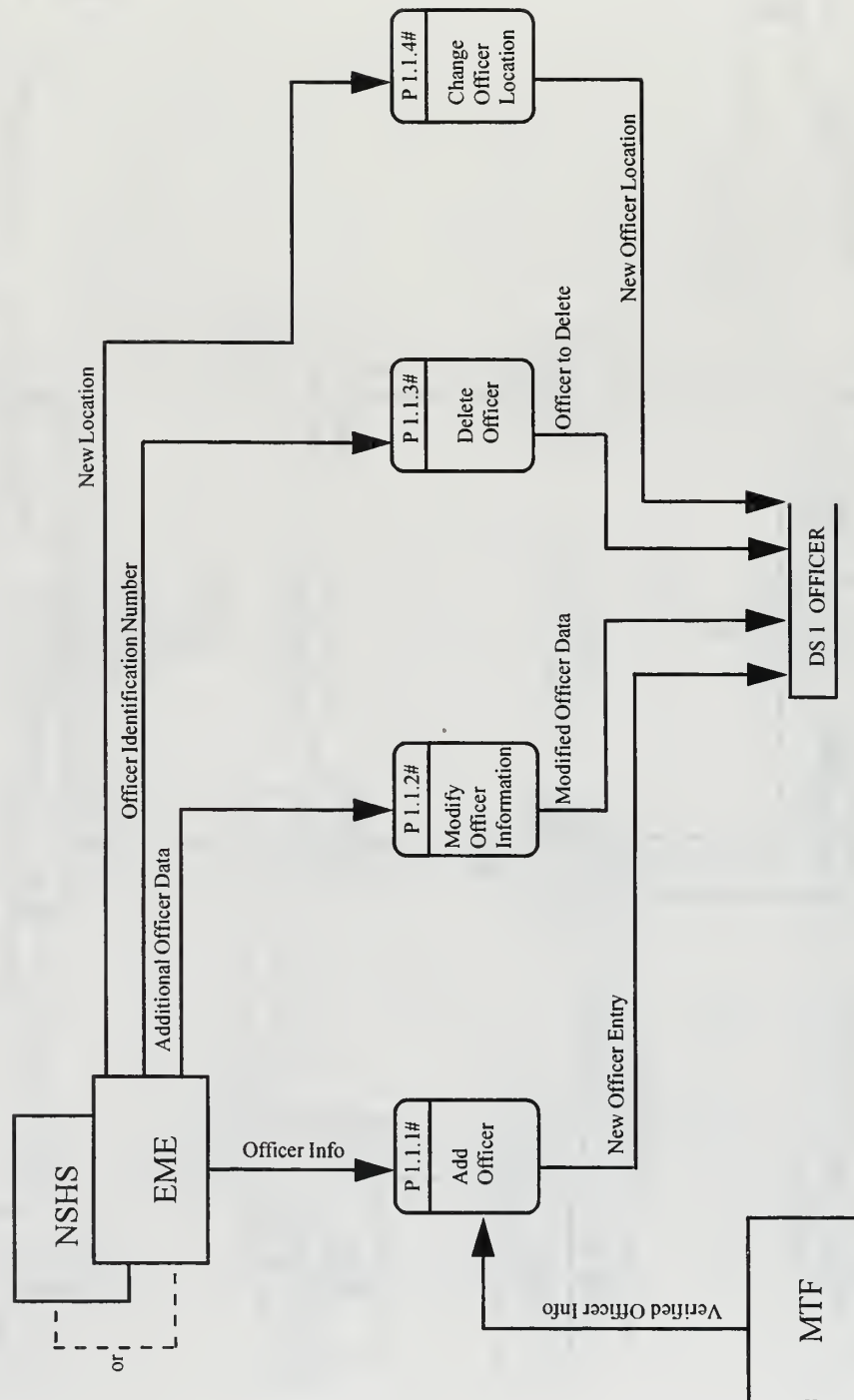


Figure D-4. Level 2 Process 1.1 Chart

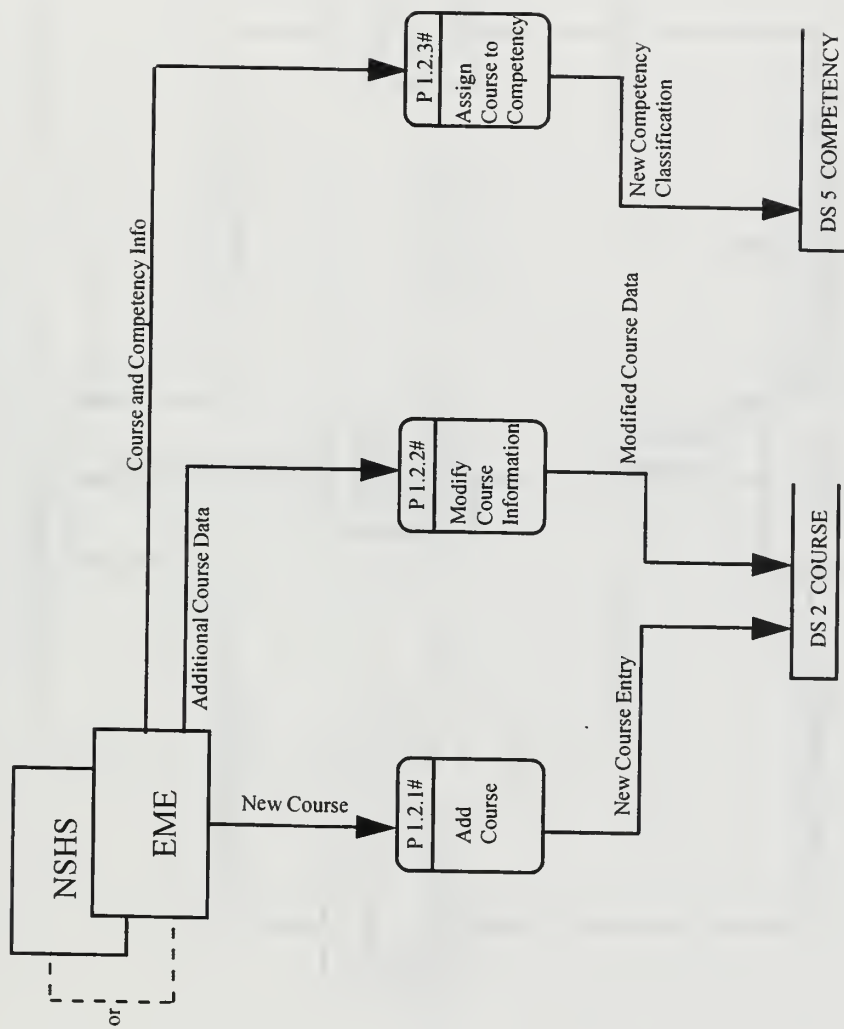


Figure D-5. Level 2 Process 1.2 Chart

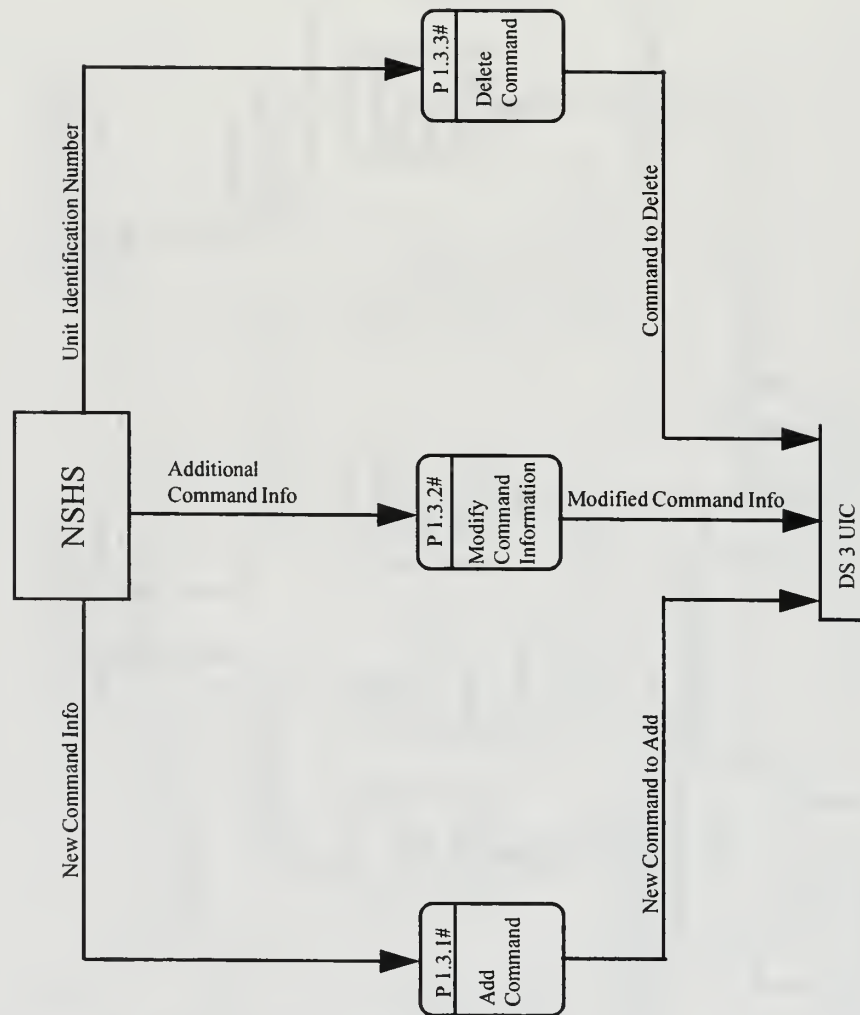


Figure D-6. Level 2 Process 1.3 Chart

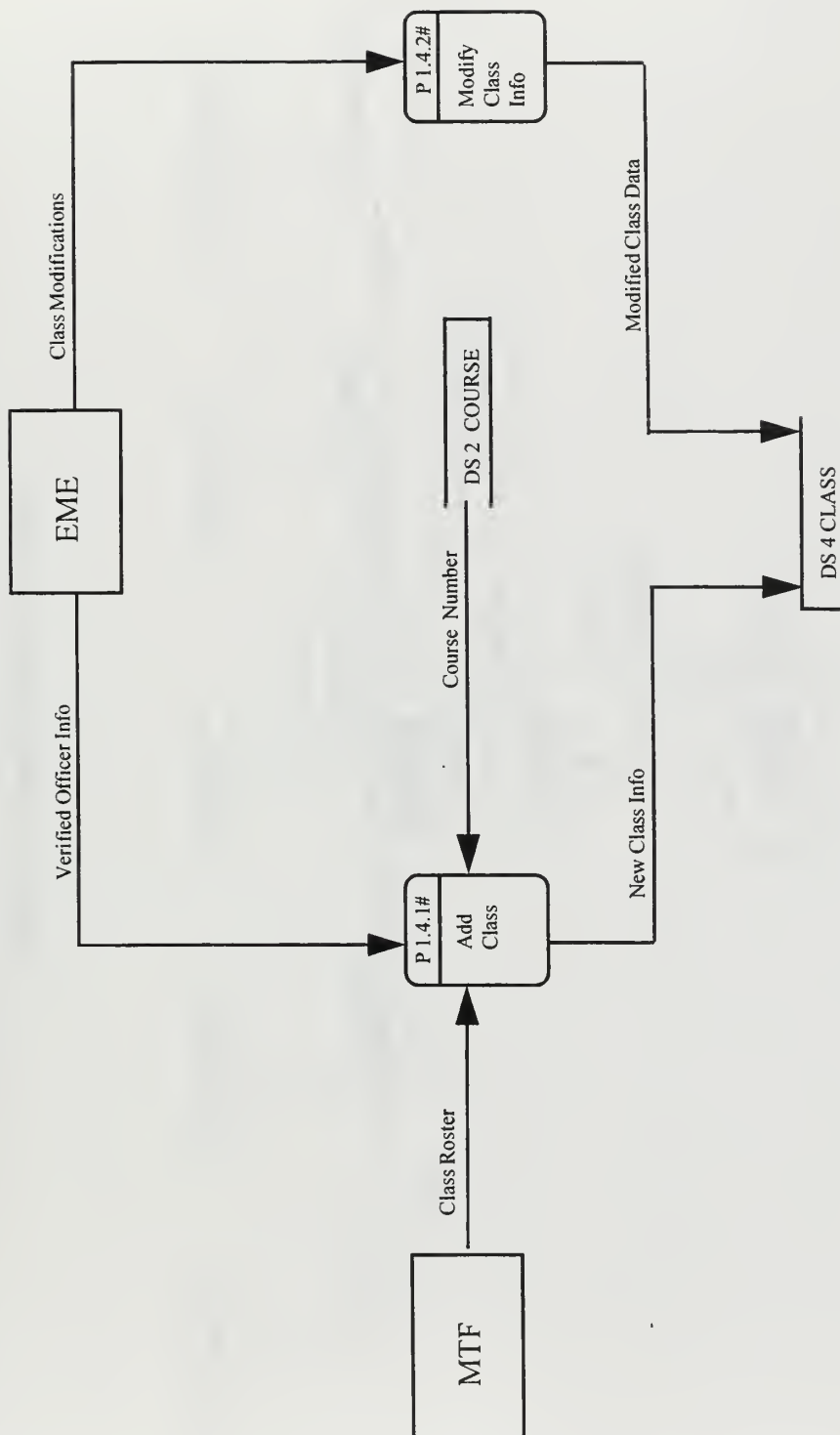


Figure D-7. Level 2 Process 1.4 Chart

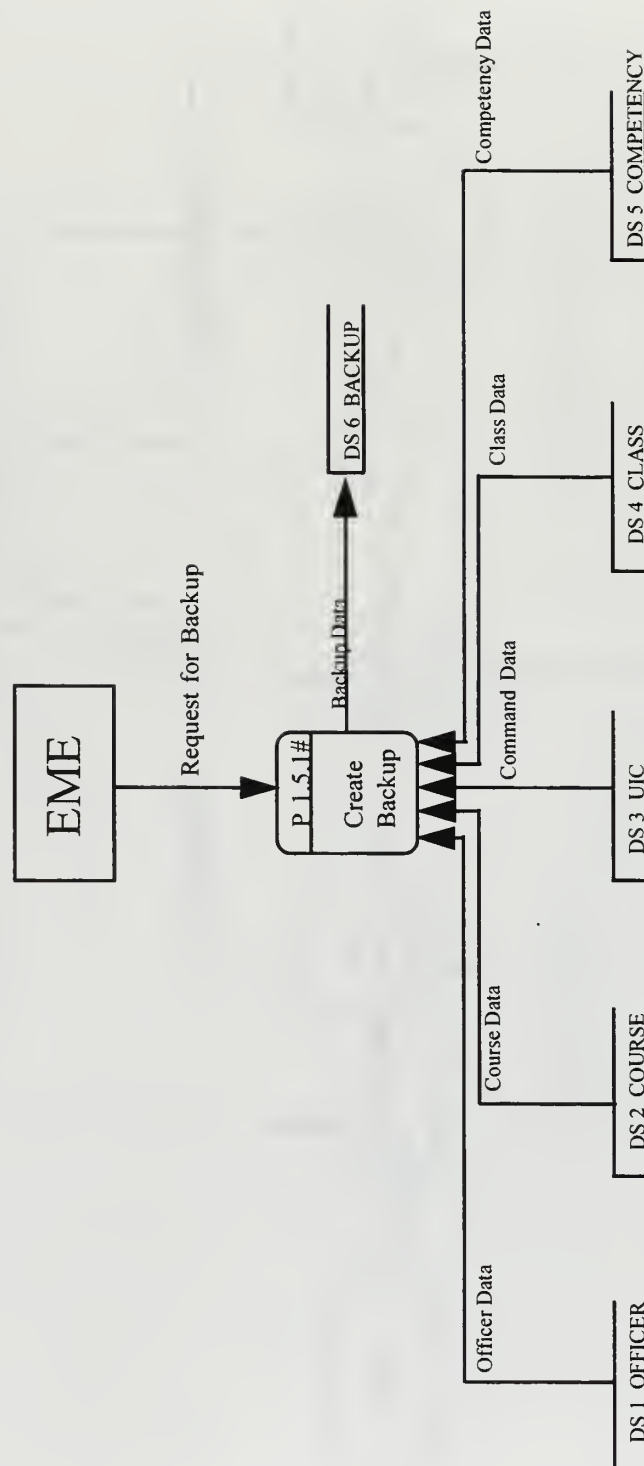


Figure D-8. Level 2 Process 1.5.1 Chart

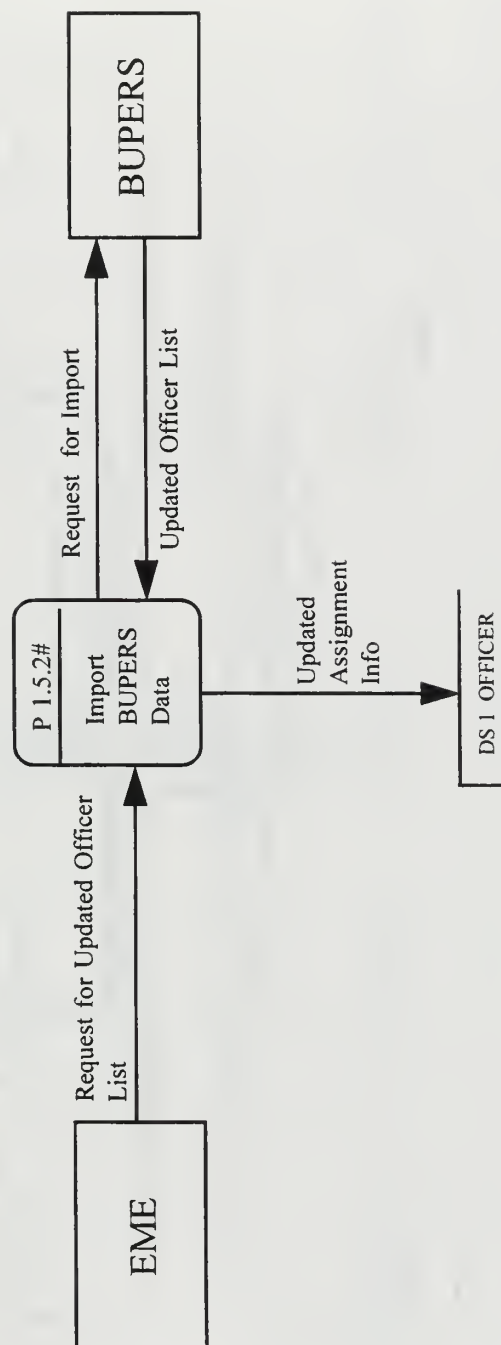


Figure D-9. Level 2 Process 1.5.2 Chart

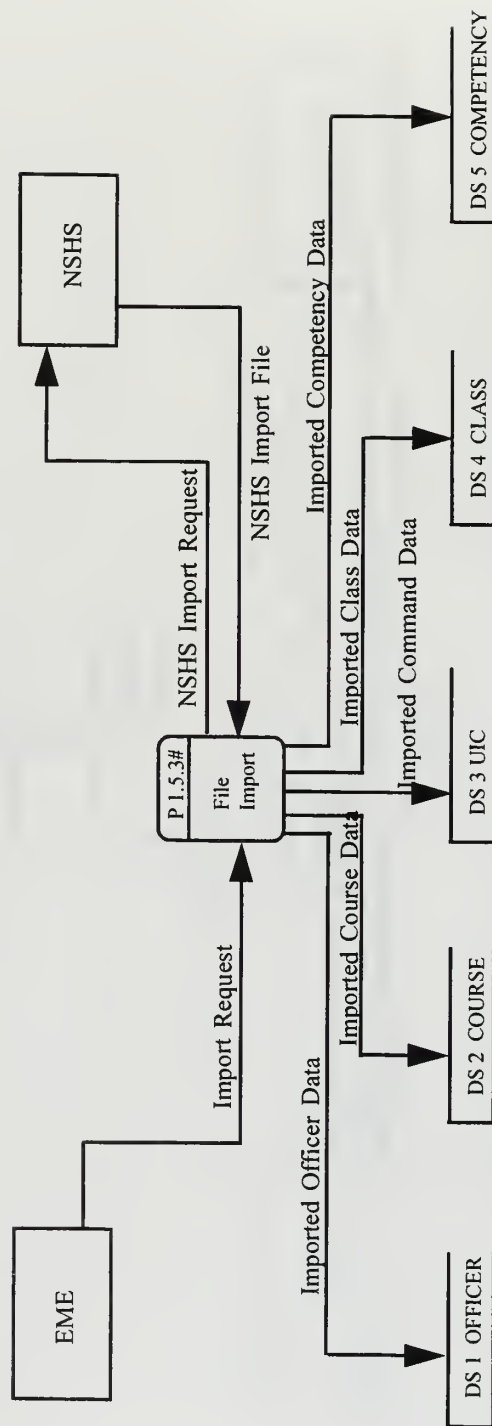


Figure D-10. Level 2 Process 1.5.3 Chart

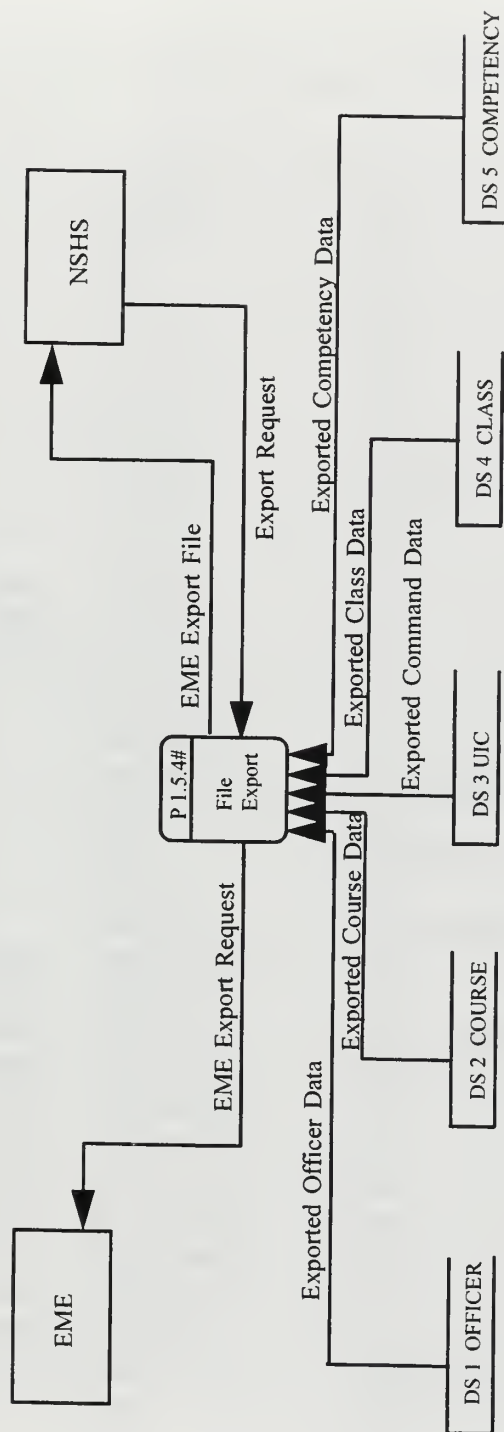


Figure D-11. Level 2 Process 1.5.4 Chart

APPENDIX E. PROTOTYPE DATA DICTIONARY

This appendix lists all of the data elements in the EMETRAK prototype system by table and field name.

Data Item	Table Name	Field Name	Type	Size	Index
1	CLASS	ClassState	Text	2	
2	CLASS	SSN	Text	11	PrimaryKey
3	CLASS	ClassZip	Text	10	
4	CLASS	ClassCity	Text	25	
5	CLASS	ClassStreet	Text	35	
6	CLASS	HostCommand	Text	35	
7	CLASS	Instructor	Text	25	
8	CLASS	ClassDate	Date/Time	8	
9	CLASS	CourseID	Text	6	PrimaryKey
10	CLASS	FormLetter	Yes/No	1	
11	COMPCOURSE	Competency	Text	50	PrimaryKey
12	COMPCOURSE	CourseID	Text	6	PrimaryKey
13	COMPETENCYCAT	Competency	Text	50	
14	COURSE	CourseName	Text	100	
15	COURSE	CourseSponsor	Text	50	
16	COURSE	EMEProgInfo	Number (Integer)	2	
17	COURSE	CourseDescription	Memo	-	
18	COURSE	Hours	Number (Double)	8	
19	COURSE	CourseID	Text	6	PrimaryKey
20	COURSE	CEUCredits	Number (Double)	8	
21	EMEPROGINFO	EMEProgOffPhone	Text	13	
22	EMEPROGINFO	EMEDSNPhone	Text	8	
23	EMEPROGINFO	EMEProgInfo	Number (Integer)	2	PrimaryKey
24	EMEPROGINFO	ProgCoordLName	Text	25	
25	EMEPROGINFO	ProgCoordFName	Text	15	
26	EMEPROGINFO	ProgCoordMInit	Text	1	
27	EMEPROGINFO	ProgCoordTitle1	Text	10	
28	EMEPROGINFO	ProgCoordTitle2	Text	35	
29	EMEPROGINFO	ProgCoordTitle3	Text	25	
30	EMEPROGINFO	NPSDeptName	Text	50	
31	LISTOFREPORTS	ReportName	Text	50	
32	LISTOFREPORTS	ReportNumber	Number (Integer)	2	
34	OFFICER	SSN	Text	11	PrimaryKey
35	OFFICER	Email	Text	25	
36	OFFICER	JobTitle	Text	50	
37	OFFICER	SubSpecialty	Text	6	
38	OFFICER	Designator	Text	5	

39	OFFICER	BSC	Text	6	
40	OFFICER	Service	Text	4	
41	OFFICER	Rank	Text	4	
42	OFFICER	Initial	Text	1	
43	OFFICER	FirstName	Text	15	
44	OFFICER	LastName	Text	25	
45	OFFICER	UIC	Text	6	
46	UIC	UICName	Text	45	
47	UIC	HealthSvcRegion	Number (Integer)	2	
48	UIC	UICType	Text	1	
49	UIC	UICFax	Text	13	
50	UIC	UICDSNPhone	Text	7	
51	UIC	UICPhone	Text	13	
52	UIC	UICZip	Text	10	
53	UIC	UICState	Text	2	
54	UIC	UICStreet	Text	30	
55	UIC	UICTitle	Text	50	
56	UIC	UIC	Text	6	PrimaryKey
57	UIC	UICCity	Text	25	

APPENDIX F. PROTOTYPE SYSTEM QUERIES

This section describes the significant system queries written for the EMETRAK prototype system. The queries were written in the MS Access version of SQL which is slightly different than the ANSI standard.

1. qryOfficersbyAlpha

This query lists the officers in the database in alphabetical order. The result is ordered by last name then first name.

```
SELECT DISTINCTROW OFFICER.SSN, OFFICER.LastName, OFFICER.FirstName,  
OFFICER.Minitial, OFFICER.Rank, OFFICER.BSC, OFFICER.Designator,  
OFFICER.SubSpecialty, OFFICER.JobTitle, OFFICER.Email, OFFICER.UIC,  
UIC.UICName, UIC.UICStreet, UIC.UICCity, UIC.UICState, UIC.UICZip,  
UIC.UICPhone, UIC.UICDSNPhone  
FROM UIC INNER JOIN OFFICER ON UIC.UIC = OFFICER.UIC  
ORDER BY OFFICER.LastName, OFFICER.FirstName;
```

2. qryOfficersbyUIC

This query lists the officers in the database in alphabetical order grouped by command and health service region.

```
SELECT DISTINCTROW UIC.UICName, UIC.UICState, UIC.HealthSvcRegion,  
OFFICER.*  
FROM UIC INNER JOIN OFFICER ON UIC.UIC = OFFICER.UIC  
ORDER BY UIC.HealthSvcRegion, OFFICER.LastName;
```

3. qryEMELongCourses

This query lists all full-length courses in the EME program syllabus ordered by course ID number.

```
SELECT DISTINCTROW COURSE.CourseID, COURSE.CourseName,  
COURSE.CourseDescription, COURSE.Hours, COURSE.CourseSponsor  
FROM COURSE  
WHERE ((COURSE.CourseID Not Like "*a"))  
ORDER BY COURSE.CourseID;
```

4. qryClassLast90Days

This query lists all classes completed in the last 90 days ordered by class date, course ID number, and officer's last name.

```
SELECT DISTINCTROW CLASS.ClassDate, CLASS.CourseID,  
COURSE.CourseName, OFFICER.LastName, OFFICER.FirstName, OFFICER.Minitial,  
OFFICER.Rank, OFFICER.Designator, CLASS.SSN, OFFICER.JobTitle,  
OFFICER.UIC, CLASS.Instructor, COURSE.Hours, CLASS.HostCommand,  
CLASS.ClassStreet, CLASS.ClassCity, CLASS.ClassState, CLASS.ClassZip  
FROM COURSE INNER JOIN (OFFICER INNER JOIN CLASS ON OFFICER.SSN =  
CLASS.SSN) ON COURSE.CourseID = CLASS.CourseID  
WHERE ((CLASS.ClassDate>Date()-90))  
ORDER BY CLASS.ClassDate, CLASS.CourseID, OFFICER.LastName,  
OFFICER.FirstName;
```

5. qryClassDateName

This query lists the classes completed by a specific officer based on last name or SSN input.

```
SELECT DISTINCTROW OFFICER.SSN, OFFICER.LastName, OFFICER.FirstName,  
OFFICER.Minitial, OFFICER.Rank, COURSE.CourseID, CLASS.ClassDate,  
COURSE.CourseName, OFFICER.UIC
```

```

FROM COURSE INNER JOIN (OFFICER INNER JOIN CLASS ON OFFICER.SSN =
CLASS.SSN) ON COURSE.CourseID = CLASS.CourseID
WHERE ((OFFICER.SSN Like InputBox$("Enter the Officer's SSN or Press Enter for
Name Only Search","SSN","") & "*") AND (OFFICER.LastName Like
InputBox$("Enter the Officer's Name or Press Enter for a SSN Search","Officer
Name","") & "*"))
ORDER BY OFFICER.LastName, OFFICER.FirstName;

```

6. qryCoursesbyCompetency

This query lists all EME courses grouped by competency category.

```

SELECT DISTINCTROW COMPCOURSE.Competency, COURSE.CourseID,
COURSE.CourseName, COURSE.Hours
FROM COURSE INNER JOIN COMPCOURSE ON COURSE.CourseID =
COMPCOURSE.CourseID
GROUP BY COMPCOURSE.Competency, COURSE.CourseID,
COURSE.CourseName, COURSE.Hours
HAVING ((COURSE.CourseID Not Like "*a"))
ORDER BY COURSE.CourseID;

```

7. qryCompletedModulesbyOfficer

This query provides a comprehensive listing of all officers in the database and the EME courses that they have completed. The results are ordered by last name and course ID number.

```

SELECT DISTINCTROW OFFICER.*, CLASS.*, COURSE.*, UIC.*
FROM COURSE INNER JOIN ((UIC INNER JOIN OFFICER ON UIC.UIC =
OFFICER.UIC) INNER JOIN CLASS ON OFFICER.SSN = CLASS.SSN) ON
COURSE.CourseID = CLASS.CourseID
WHERE ((OFFICER.LastName Like InputBox$("Enter a Last Name or Press Enter for
all Officers","Officer Name","") & "*"))
ORDER BY OFFICER.LastName, OFFICER.FirstName, OFFICER.Minitial,
CLASS.CourseID;

```


8. qryProfiler

This query selects the record set based on user input. The result is a list of officers that are of a certain rank and designator, in a specific HSR, and have completed a specific course module.

```
SELECT DISTINCTROW UIC.*, OFFICER.*, CLASS.*, COURSE.*
FROM COURSE INNER JOIN (UIC INNER JOIN (OFFICER INNER JOIN CLASS
ON OFFICER.SSN = CLASS.SSN) ON UIC.UIC = OFFICER.UIC) ON
COURSE.CourseID = CLASS.CourseID
WHERE ((CLASS.CourseID=[Forms]![Profiler]![Module])) OR
((OFFICER.Rank=[Forms]![Profiler]![Rank])) OR
((UIC.HealthSvcRegion=[Forms]![Profiler]![HSR])) OR
((OFFICER.Designator=[Forms]![Profiler]![Designator]))
ORDER BY OFFICER.LastName, OFFICER.FirstName;
```

9. qryCommands

The query results in a listing of all MTFs in the database.

```
SELECT DISTINCTROW UIC.*
FROM UIC;
```

10. qryClassCourse

This query lists course modules completed by an officer in course ID order for display on the Officer Record subform.

```
SELECT DISTINCTROW CLASS.SSN, CLASS.ClassDate, COURSE.CourseID,
COURSE.CourseName, COURSE.Hours, COURSE.CEUCredits,
COURSE.CourseSponsor, COURSE.CourseDescription, CLASS.Instructor,
CLASS.HostCommand, CLASS.ClassStreet, CLASS.ClassCity, CLASS.ClassState,
CLASS.ClassZip
FROM COURSE INNER JOIN CLASS ON COURSE.CourseID = CLASS.CourseID
ORDER BY COURSE.CourseID;
```

11. qryCompetencyCount

This query totals the number of courses and hours completed for display on the competency count subform.

```
SELECT DISTINCTROW COMPCOURSE.Competency, CLASS.SSN,  
Count(COURSE.CourseID) AS HowManyCourses, Sum(COURSE.Hours) AS  
TotalHours  
FROM (COURSE INNER JOIN CLASS ON COURSE.CourseID = CLASS.CourseID)  
INNER JOIN (COMPETENCYCAT INNER JOIN COMPCOURSE ON  
COMPETENCYCAT.Competency = COMPCOURSE.Competency) ON  
COURSE.CourseID = COMPCOURSE.CourseID  
GROUP BY COMPCOURSE.Competency, CLASS.SSN  
ORDER BY CLASS.SSN;
```

12. qryEMEShortCourses

This query lists abbreviated courses in the EME syllabus ordered by course ID number.

```
SELECT DISTINCTROW COURSE.CourseID, COURSE.CourseName,  
COURSE.Hours  
FROM COURSE  
WHERE ((COURSE.CourseID Like "*a"))  
ORDER BY COURSE.CourseID;
```

13. qryOfficersbyCourseID

This query lists the officers that have completed a particular course based on the course ID number selected.

```
SELECT DISTINCTROW CLASS.SSN, OFFICER.LastName, OFFICER.UIC  
FROM OFFICER INNER JOIN CLASS ON OFFICER.SSN = CLASS.SSN  
WHERE ((CLASS.CourseID Like InputBox$("Enter a Course ID  
Number","CourseID")));
```

14. qryWholeEnchilada

This query lists all of the data pertinent to officers in the database based on UIC number or UIC name input.

```
SELECT DISTINCTROW UIC.*, OFFICER.*, CLASS.*, COURSE.*,  
COMPETENCYCAT.*, COMPCOURSE.*, COMPCOURSE.*  
FROM (COURSE INNER JOIN ((UIC INNER JOIN OFFICER ON UIC.UIC =  
OFFICER.UIC) INNER JOIN CLASS ON OFFICER.SSN = CLASS.SSN) ON  
COURSE.CourseID = CLASS.CourseID) INNER JOIN (COMPETENCYCAT INNER  
JOIN COMPCOURSE ON COMPETENCYCAT.Competency =  
COMPCOURSE.Competency) ON COURSE.CourseID = COMPCOURSE.CourseID  
WHERE ((UIC.UIC Like InputBox$("Enter a Specific UIC or Press Enter for all  
Commands", "Command Name", "") & "*"))  
ORDER BY UIC.UICName, OFFICER.LastName, OFFICER.FirstName,  
CLASS.CourseID;
```

APPENDIX G. PROTOTYPE SYSTEM REPORTS

This appendix describes the pre-formatted reports currently available in the EMETRAK prototype system.

1. Officers in Alphabetical Order (Figure G-1)

This report provides a listing of all officers in the database in alphabetical order. The report prints the officer's SSN, Name, Rank, Billet Sequence Code, Designator, Sub-specialty Code, Job Title, and UIC Name fields. The report is designed for program administration purposes in order to verify basic officer information contained in the database.

2. Officers by UIC (Figure G-2)

This report lists all of the officers in the database grouped by major command. The officers appear in alphabetical order under the appropriate command sub-head. The report is designed for program administration purposes to verify officer location and billet status.

3. List of EME Courses (Figure G-3)

This report lists all course modules available in the EME curriculum. The courses are ordered by course ID number. Course number, course title, course description, hours and course sponsor are printed in the body of the report. The total curriculum hours are summed at the end of the report. This report is designed for distribution as an abbreviated course catalog.

4. 90-Day Class Report (Figure G-4)

The 90-day Class Report is a listing of all course modules provided by the EME staff in the preceding ninety day period. The report lists all courses, the dates provided, and the officers that received the instruction. The report is designed as a program management tool to validate the course delivery schedule and verify data entry.

5. Detailed Report in Alphabetical Order (Figure G-5)

The detailed report lists all of the courses and hours completed by an individual officer based on the name or SSN input by the end-user. It is designed as an unofficial transcript for distribution to participating officers upon request.

6. Courses by Competency (Figure G-6)

This report lists EME courses grouped according to the DOD competency category. The course ID number, course title, and hours are listed in course number order.

7. Detailed Report in Command Order (Figure G-7)

This report is similar to the previously mentioned “alphabetical order detailed report”, except that the officers are grouped by command. The report will list a specific officer based on end-user selection or list all officers in the database. It is intended to provide a comprehensive listing of officers and their program history as a back-up paper record.

8. Profiler (Figure G-8)

The Profiler is an ad hoc report that allows the end-user to specify certain selection criteria. The user may choose the Designator, Rank, HSR, and Course ID of interest. In return, the report lists the officers in alphabetical order that meet the particular profile.

9. List of Commands (Figure G-9)

This report provides information about the commands in the database. The command UIC, command name, mailing address, telephone number, and HSR are listed.

10. Course Completion Letter (Figure G-10)

This report provides formal documentation about EME courses completed by an individual officer. The letters are generated soon after course completion information is entered into the database. The report is in standard naval letter format printed for the program coordinator's signature.

10. Completion Certificate (Figure G-11)

This report is a completion certificate that shows the number of CEU credits earned by the officer during a given period. The report is printed on color certificate paper and totals the number of CEU hours earned since the last certificate was issued.

TRAK *Officers in Alphabetical Order*

SSN	Name	Rank	BSC	Desig:	Sub:	Job Title	UIC Name
064-38-5084	Alden, William _	CAPT	999	2900		Director for Nursing	Naval Hospital, Jacksonville
454-38-7104	Arthur, Arthur A	CAPT	999	2100		Commanding Officer	NMC San Diego
111-11-2222	Balboa, Rocky S	LTJG	28237	2300	1999	PRT Coordinator	Naval Hospital, Naples
087-36-6922	Bendan, Andrew F	CAPT	999	2200		Deputy commander, BUMED, MED-66	Bureau of Medicine and Surgery
085-42-4723	Bolden, Joan _	CAPT	999	2900		Director for Nursing Services	Naval Hospital, Camp Lejeune
043-46-9999	Clifford, Clark _	LCDR	999	2900		Head, Military Sickcall Department	Naval Hospital, Twenty-nine Palms
079-40-0005	Condor, Ken _	CDR	999	2100		QUIDA	Naval Hospital, Jacksonville
099-50-7553	Connors, Theodore E	CDR	999	2300		Director for Administration	Naval Hospital, Twenty-nine Palms
012-38-4000	Desmond, Paul M	LCDR	999	2300		Head, Logistics Services Dept	Naval Hospital, Camp Lejeune
262-28-8222	Dorris, Michael K	CAPT	999	2900		XO	Naval Hospital, Beaufort
078-38-4949	Foster, Richard C	CDR	999	2300		Director for Administration	Naval Hospital, Cherry Point
013-40-0000	Grath, Paul _	LCDR	999	2300		Head, Food Management Department	Naval Hospital, Twenty-nine Palms
333-44-3165	Grenier, Mark _	LCDR	999	2300		Head, Management Information Department	Naval Hospital, Jacksonville
022-36-5555	Hardy, Richard P	CAPT	999	2100		OIC, Navy Doctrine Command	Naval Doctrine Command Det HSS
263-36-6091	Henderson, Steven J	CAPT	999	2300		Director, Student Health Services	Student Health Svcs, Georgetown University
299-38-6280	Palton, Erik A	LCDR	999	2300		Head, Physical Therapy Department	Naval Hospital, Camp Lejeune
995-73-9009	Rhodes, Donna M	CDR	999	2900		Head, Surgical Nursing	Naval Hospital, Jacksonville
107-44-0000	Stevens, David _	LCDR	999	2100		General Surgery Dept, 2nd Medical Battalion	Naval Hospital, Camp Lejeune
111-11-1111	Tester, Test T	LCDR	11111	1011		Head, Testing	Unknown UIC
284-90-8357	Tollison, Beverly B	LCDR	999	2900		Head, Administration Dept	BMC MCLB ALBANY GA
043-58-1965	Travers, Nancy _	CDR	999	2900		Nurse Manager, Sports Medicine	Naval Hospital, Camp Lejeune

Figure G-1



Officers By UIC

Page: 1

00018 - Bureau of Medicine and Surgery, DC							Region: 1
SSN	Name	Rank	BSC	Desig:	Sub:	Job Title	Email
087-36-6922	Bendan, Andrew F	CAPT	999	2200		Deputy commander, BUMED, MED-66	
00232 - Naval Hospital, Jacksonville, FL							Region: 3
SSN	Name	Rank	BSC	Desig:	Sub:	Job Title	Email
064-38-5084	Alden, William _	CAPT	999	2900		Director for Nursing	
079-40-0005	Condor, Ken _	CDR	999	2100		QUIDA	
333-44-3165	Grenier, Mark _	LCDR	999	2300		Head, Management Information Department	
995-73-9009	Rhodes, Donna M	CDR	999	2900		Head, Surgical Nursing	
00259 - NMC San Diego, CA							Region: 9
SSN	Name	Rank	BSC	Desig:	Sub:	Job Title	Email
454-38-7104	Arthur, Arthur A	CAPT	999	2100		Commanding Officer	
11111 - Unknown UIC, TN							Region: 4
SSN	Name	Rank	BSC	Desig:	Sub:	Job Title	Email
111-11-1111	Tester, Test T	LCDR	11111	1011		Head, Testing	test@tester.navy.mil
35298 -							Region: 14
SSN	Name	Rank	BSC	Desig:	Sub:	Job Title	Email
284-90-8357	Tollison, Beverly B	LCDR	999	2900		Head, Administration Dept	
35949 - Naval Hospital, Twenty-nine Palms, CA							Region: 9
SSN	Name	Rank	BSC	Desig:	Sub:	Job Title	Email
043-46-9999	Clifford, Clark _	LCDR	999	2900		Head, Military Sickcall Department	
099-50-7563	Connors, Theodore E	CDR	999	2300		Director for Administration	
013-40-0000	Grath, Paul _	LCDR	999	2300		Head, Food Management Department	

Figure G-2

08-Apr-96 Page: 1 **EMIE TRAK** List of EME Courses

ID	Course Name	Course Description	Hours	Sponsor
1	Understanding and Effectively Using Communication Media	This is a sample course description for the purpose of report generation. This is the first course in the sequence for the EME Program and sets the standard for the rest of the program.	4.00	NPS
2	Communication Vision and Change in a Complex System		4.00	NPS
3	Empowering Associates Through Strategic Feedback		4.00	NPS
4	Bottom-Line and High Impact Health Care Communications		8.00	NPS
5	Listening for Success		4.00	NPS
6	Meeting Management		4.00	NPS
7	A Practical Approach to Strategic Planning		24.00	NPS
8	Health Care Marketplace Dynamics		16.00	NPS
9	Stakeholder Management and Mapping the Health Care Environment		8.00	NPS
10	Integrating Warfare, Emergency, Crisis Contingencies into the Strategic Pla		8.00	NPS
11	Total Quality Leadership - The Theory		8.00	NPS
12	Total Quality Leadership - The Context		8.00	NPS
13	Total Quality Leadership - The Application		8.00	NPS
14	Quantitative Analysis for Health Care Administration		24.00	NPS
15	Tools for Effective Management Under Risk and Uncertainty		8.00	NPS
16	Analytic Tools to Support Decision Making in Health Care		8.00	NPS
17	Cost-output Analysis: A Decision Making Support Tool		8.00	NPS
18	Effective Information Systems		4.00	NPS
19	Hospital Information Systems in the 90's		8.00	NPS
20	Managing Hospital Information Systems (HIS)		16.00	NPS

Figure G-3


<div> <div>  </div> <div> Detailed Report in Alphabetical Order </div> </div>									
08-Apr-96									
Page: 1									
Course ID	Course Title	Instructor	Class Date	BSC 999	Class Address	Course Hours	CEU Hours		
012-38-4000	Desmond, Paul M	LCDR	Design: 2300	Sub:	Job Title: Head, Logistics Services Dept				
41	Managing Change in a Military Health Care Setting	Roberts	7/26/95		Camp Lejeune	NC	12.00	12.00	
45	Leadership and Motivation	Crawford	7/27/95		Camp Lejeune	NC	6.00	6.00	
46	Managing Teams in Complex Health Care Environments	Thomas	7/27/95		Camp Lejeune	NC	8.00	8.00	
						Total:	26.00	26.00	

Figure G-5

Competency: Acquisition Process

Course ID	Course Name	Hours
38	Defense Acquisition Process and Health Care Implications	8

Competency: Alternative Health Care Delivery Systems

Course ID	Course Name	Hours
23	Alternative Health Care Delivery Systems	6

Competency: Communication

Course ID	Course Name	Hours
1	Understanding and Effectively Using Communication Media	4
2	Communication Vision and Change in a Complex System	4
3	Empowering Associates Through Strategic Feedback	4
4	Bottom-Line and High Impact Health Care Communications	8
5	Listening for Success	4
6	Meeting Management	4
47	Working in Teams	8

Competency: Conflict Resolution

Course ID	Course Name	Hours
44	Labor/Management Relations/Negotiation in Health Care	12
48	Conflict Management and Negotiation	4

Figure G-6

08-Apr-96

Detailed Report in Command Order

Page: 1

Course ID	Course Title	Instructor	Class Date	Class Address	Course Hours	CEU Hours
00018 - Bureau of Medicine and Surgery						
Region: 1						
087-36-6922	Bendian, Andrew F	CAPT	Desig: 2200	Sub: BSC 999	Job Title: Deputy commander, BUMED, MED-	
9A	Stakeholder Management and Mapping the Health Care Envi	N Roberts	9/19/95	1 Old Golf Course Rd	Monterey	CA 3.00
18A	Effective Information Systems	Emery/Frew	9/21/95	1 Old Golf Course Rd	Monterey	CA 4.00
24A	Budgeting for Defense Health	Doyle	9/20/95	1 Old Golf Course Rd	Monterey	CA 2.00
30A	The Accounting Model and Financial Reporting	Euske	9/20/95	1 Old Golf Course Rd	Monterey	CA 2.00
31A	Management Accounting: Application to Health Care	Euske	9/20/95	1 Old Golf Course Rd	Monterey	CA 2.00
36A	Productivity Measurement and Incentives	Gates	9/20/95	1 Old Golf Course Rd	Monterey	CA 2.00
38A	Defense Acquisition Process and Health Care Implications	Desbrow	9/21/95	1 Old Golf Course Rd	Monterey	CA 2.00
42A	Managing Change in Health Care: Creating a Learning Orga	Harris/Barrett	9/18/95	1 Old Golf Course Rd	Monterey	CA 5.00
49A	Empowerment in Navy Health Care	Thomas	9/19/95	1 Old Golf Course Rd	Monterey	CA 2.00
Total:						24.00

Figure G-7



 TRAK		Profile Report				08-Apr-96			
		Desig: 2900	SSN	Desig	Job Title	UIC Name	Phone	DSN	
Module: 94		Page: 1							
Dorris, Michael K		CAPT	262-28-8222	2900	XO	Naval Hospital, Beaufort	(803) 525-5302		

Figure G-8

08-Apr-96



List of Commands

		Page: 1		
UIC	Command Name	Address	Comm Phone/Fax	DSN Phone Region
00018	Bureau of Medicine and Surgery	2300 E Street NW Washington, DC 20372-5300	(202) 653-1250 (202) 653-0545	294-1250 1
00232	Naval Hospital, Jacksonville	2080 Child Street Jacksonville, FL 32214-5000	(904) 777-7464	942-7464 3
00259	NMC San Diego	34800 Bob Wilson Drive San Diego, CA 92134-5000	(619) 532-6411 (619) 532-6333	9
11111	Unknown UIC	1 Dont Know Street Testville, TN 11111	(111) 111-1111	4
35298	BMC MCLB ALBANY GA			14
35949	Naval Hospital, Twenty-nine Palms	Box 788250 Twenty-nine Palms, CA 92278-	(619) 830-2647	957-2647 9
49723	Naval Doctrine Command Det HSS	2200 Lester Street Quantico, VA 22134-6050	(703) 784-4502 (703) 278-4509	278-4502 2
49768	TR NYU NEW YORK			14
49864	BMC MISAWA JA			14
49871	HLTHCARE SUPPO JAX DET MIL			14

Figure G-9

08 April 1996

From: Executive Director, Institute for Defense Education and Analysis, Naval Postgraduate School
To: LCDR Paul Desmond, 012-38-4000

Subj: **EXECUTIVE MANAGEMENT EDUCATION PROGRAM MODULE COMPLETION**

1. This letter certifies that you have completed the requirements for the following course module(s) as part of the Executive Management Education Program:

Number	Course Title	Instructor	Hours
45	Leadership and Motivation	Crawford	6.00
Class Date: 7/27/95 Location: Camp Lejeune, NC			

2. Questions concerning module completion should be directed to the EME Program Staff at the Naval Postgraduate School, commercial telephone (408) 656-2792 or DSN 878-2792.

S. R. Lamar, Ph.D.
CAPT, MSC, USN (Ret)

Figure G-10

Certificate of Completion

This is to certify that

LCDR P Desimone, MSC, USN

has successfully completed

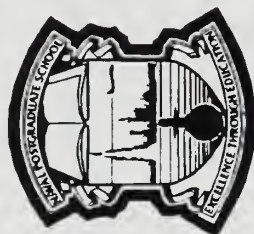
26

Continuing Education Units of

Executive Management Education Program Courses

on July 27, 1995

in Camp Lejeune, NC



David R. Whipple, Ph.D.

Director

Institute for Defense Education and Analysis

RADM M. J. Evans, USN

Superintendent

Naval Postgraduate School

The Naval School of Health Sciences (NSHS) Bethesda is accredited by the American Osteopathic Association (AOA) and the Accreditation Council for Continuing Medical Education (ACCME) to approve continuing medical education for physicians. NSHS designates this continuing medical education as Category 1B (AOA) and Category 1 of the Physician's Recognition Award of the American Medical Association. The U. S. Navy Dental Corps is an ADA CERP recognized provider. One credit hour may be claimed for each hour of participation. The Institute for Defense Education and Analysis is approved as a provider of nurses continuing education by the NSHS, which is accredited as an approver of continuing education in nursing by the American Nurses Credentialing Center of the American Nurses Association.

Figure G-11

APPENDIX H. PROTOTYPE SYSTEM FUNCTIONS

This section contains Access Basic code for two of the major system functions that reside in the prototype's module container. Additional coding was required to achieve the desired functionality, however, it was written as code behind the form (CBF) and is not included in this section. The functions were modified from examples listed in Reference 15.

Function AutoExec () `This function sets global properties for the prototype
 ` application and takes the user to the Officer Record form
 ` when the application file is opened.

```
Const A_WINDOWMENU = 4
Const A_HIDE = 3
```

```
On Error GoTo AutoExec_Err
```

```
Dim dbCurrent As Database
Dim rstPreload As Recordset
Dim intPreload As Integer
Dim varRet As Variant
```

```
DoCmd Hourglass True
```

```
Application.SetOption "Built-In Toolbars Available", False
```

```
If Not SysCmd(SYSCMD_RUNTIME) Then
    DoCmd SelectObject A_MACRO, "AutoExec", True
    DoCmd DoMenuItem A_FORMBAR, A_WINDOWMENU, A_HIDE
    DoCmd OpenForm "frmSplash"
    DoEvents
End If
```

```
Set dbCurrent = DBEngine.Workspaces(0).Databases(0)
Set rstPreload = dbCurrent.OpenRecordset("qryPreload", DB_OPEN_SNAPSHOT)
rstPreload.MoveLast
intPreload = rstPreload.RecordCount
varRet = SysCmd(SYSCMD_INITMETER, "EMETRAK is initializing...", intPreload)
```

```

intPreload = 1

rstPreload.MoveFirst
Do Until rstPreload.EOF
    DoCmd OpenForm rstPreload![FormName], , , , A_HIDDEN
    varRet = SysCmd(SYSCMD_UPDATEMETER, intPreload)
    intPreload = intPreload + 1
    rstPreload.MoveNext
Loop

```

```

DoCmd Close
DoCmd OpenForm "OfficerRecord"

```

```

AutoExec_Exit:
    rstPreload.Close
    varRet = SysCmd(SYSCMD_REMOVEMETER)
    DoCmd Hourglass False
    Exit Function

```

```

AutoExec_Err:
    MsgBox "Error" & Err & ": " & Error$, 0, "AutoExec"
    Resume AutoExec_Exit

```

```

End Function

```

```

*****

```

```

Function QuitandExit_Click ()    `This function resets normal Access properties
                                `upon exit from the prototype application.

```

```

    On Error GoTo Err_QuitandExit_Click

```

```

    Application.SetOption "Built-in Toolbars Available", True
    DoCmd Quit

```

```

Exit_QuitandExit_Click:
    Exit Function

```

```

Err_QuitandExit_Click:
    MsgBox Error$
    Resume Exit_QuitandExit_Click
End Function

```

APPENDIX I. PROTOTYPE SYSTEM USER'S GUIDE

A. INTRODUCTION

EMETRAK is a powerful, yet easy to use windows-based database application. The application is designed to collect, maintain, and report EME program information and it accomplishes each of those functions with a minimum of key strokes or “clicks” of the mouse. EMETRAK has a simple graphical user interface and uses the “point and click” method for navigating within the database environment. A basic understanding of the Windows 3.0® or higher operating system is required and assumed as a starting point for using the EMETRAK system. EMETRAK is a Microsoft Access 2.0®-developed database application and therefore must be operated from within the Access application environment.

B. LAUNCHING THE EMETRAK APPLICATION

From Windows start Microsoft Access 2.0 by double-clicking on the Access 2.0 icon. Once inside the Access application environment, open the EMETRAK application by clicking on the open folder icon or choosing “**Open Database...**” from the “**File**” pull-down menu and selecting the EMETRAK application file (emetrak.mdb) from the appropriate directory (Figure I-1). Double clicking on the file name (emetrak.mdb) or selecting the file and choosing OK will automatically launch the application.

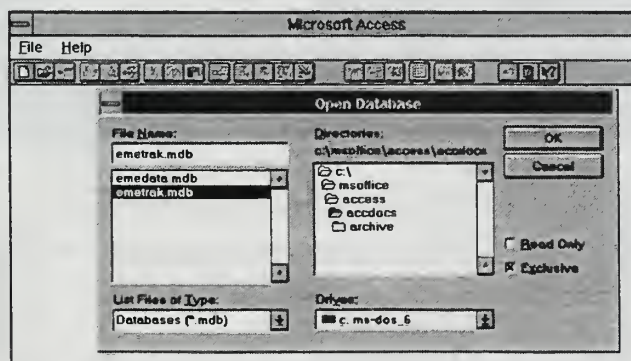


Figure I-1. Open Database Window

It normally takes several seconds for the application files to initialize and open. The EMETRAK application centers around the participating officer and, consequently, opens to the Officer Record form (Figure I-2) as the main input screen.

C. WORKING WITH THE OFFICER RECORD FORM

The Officer Record form serves as an interface between the system user and the data stored in the application's database tables. Let's take a moment to navigate around the form.

There are several fields (or windows) on the form that contain information about the officer. The fields are:

- SSN The officer's social security number
- Name The officer's name (Last name , first name , middle initial)
- Rank The officer's rank (e.g. LCDR, CDR, etc.)
- Service USN, USA, USAF, (USNR, etc. for reserve officers)

The screenshot shows the 'Officer Record' form. At the top, there is a title bar 'Officer Record' and a logo on the left. The form contains several input fields for officer information: SSN (111-11-1111), Name (Tester, Todd), Rank (LCDR), Service (USN), Designator (1011), Subspec, BSC (11111), Job Title (Head, Testing), UIC (11111), and Email (test@tester). There are also buttons for 'Display UIC', 'Add Class', 'Tables', 'Reports', and 'Competencies'. On the right side, there are several icons for different functions. Below the form fields is a table with the following data:

Class Date	Course ID	Course Name	Hours	CEU Credits	Sponsor
9/5/94	1	Understanding and Effectively Using Communication Me	4.00	4.00	NPS
6/29/95	6	Meeting Management	4.00	4.00	NPS
1/1/95	6	Stakeholder Management and Mapping the Health Care	8.00	8.00	NPS
9/19/95	9A	Stakeholder Management and Mapping the Health Care	3.00	3.00	NPS
12/31/95	13	Total Quality Leadership - The Application	8.00	8.00	NPS
1/1/95	13	Effective Information Systems	4.00	4.00	NPS

Figure I-2. Officer Record Form

- Designator The officer's designator or specialty code (2100 - Medical Corps)

(doctor), 2200 - Dental Corps (dentist), 2300 - Medical Service Corps (health care administrators, etc.), and 2900 - Nurse Corps (nurses))

- **Sub-Spec** The officer's sub-specialty code (a four or five digit alphanumeric)
- **BSC** The officer's billet sequence code (The officer's job line number)
- **Job Title** The officer's English job title description.
- **UIC** The unit identification code (a five or six digit alphanumeric) to which the officer is assigned.
- **Email** The officer's current electronic mail address

The rank, service, and UIC fields are drop-down "pick" lists which make updating the field very easy. Simply click on the arrow next to the desired field and a list of choices drop down. Select the appropriate choice and the field is automatically updated. Note: Information in these fields can be entered through the keyboard as well as selecting from the "pick" list. You should save the record after modification to ensure that the database will be updated.

There are several "action buttons" on the Officer Record form. Each button performs a specific function or displays information from the database tables.

Display UIC

The "**Display UIC**" button (next to the UIC field) displays the officer's unit mailing address and unit telephone number when it is clicked. Information on this pop-up form is read only and can not be modified from this form. Modifications to this information will be discussed in a later section.

The group of buttons on the right side of the Officer Record form allows the user to navigate from one officer record to another and perform basic file operations.



The "**Add Officer**" button allows the user to enter a new officer record. When it is clicked, all of the fields on the current Officer Record form clear and are ready for new information to be entered. An alternate method of adding a new officer record is through the "**New**" sub-menu under the "**Records**" pull-down menu.



The "**Save**" button writes (or saves) the newly added or modified information to the database. Note: If the save button is not clicked after information on the form has

been modified, the new items will not be added to database. An alternate method of saving a newly added record is through “**Save Record**” under the “**File**” pull-down menu.



The “**Search**” button uses the standard Windows “Find” function. First, click on the desired field to search. Then click the “**Search**” button. The button opens the Windows “Find” dialog box (Figure I-3).

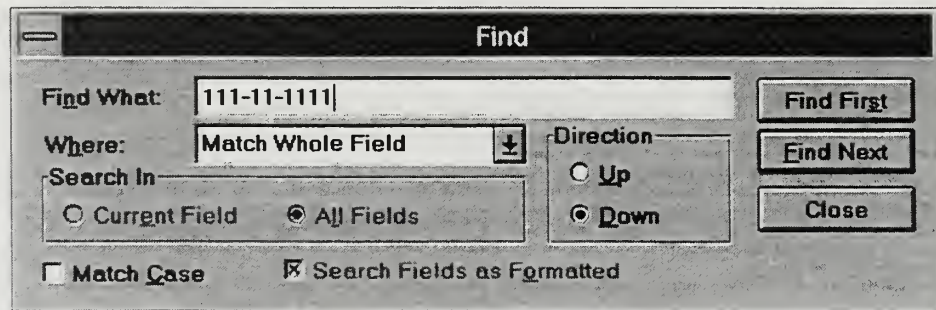


Figure I-3. Find Input Box

Once in the “Find” dialog box, enter the string of letters or numbers as required in the “Find What” field (such as the SSN 111-11-1111 depicted in the figure) and select the “Find First” button to initiate a search for the appropriate record. Close the “Find” dialog box once the search has found the appropriate record.

The “Find” function can also be selected through the application menu structure by choosing “**Edit**” and “**Find**”. Note: The “Find” dialog box will retain the data entered until you exit the application even if the dialog is closed and later reopened.



The “**Delete**” button is used to remove an officer record that has been incorrectly entered. Note: If an officer record exists in the database and has classes assigned to it, the application’s database integrity rules will prevent deletion of that officer record.



The “**Navigation Arrows**” allow the user to move from one record to the next. The officer records are ordered in ascending (least to greatest) order by SSN as a default. The records can be re-arranged in alphabetical order by last name as specified by the user. To arrange the officers in alphabetical order click on the desired field (last name), then select “**Ascending**” from the “**Quick Sort**” sub-menu under “**Records**” pull-down menu.

The buttons arranged along the middle of the Officer Record form allow the user to access other program information related to the Officer Record form.

Add Class

Clicking on the “**Add a Class**” button opens the “Add a Class” pop-up form and allows the user to enter a new class for the officer.

Tables

The “**Tables**” button takes the user to a table switchboard, from which, the user may view and/or modify data directly in the Course Modules, Competency Categories, or UIC database tables.

Reports

The “**Reports**” button takes the user to a report switchboard, from which, the user can select system reports for preview or print.

Competencies

Clicking on the “**Competencies**” button allows the user to view the officer’s completed EME hours grouped according to competency category.

The lower portion of the Officer Record form contains a sub-form which displays the classes completed by the officer (Figure I-4). This section is “read-only” and can not be modified on the Officer Record form. The scroll bars next to the information, however, allow the user to view all course information related to the officer.


Class Date	Course ID	Course Name	Hours	CEU Credits	Sponsor
9/5/94	1	Understanding and Effectively Using Communication Me	4.00	4.00	NPS
6/29/95	6	Meeting Management	4.00	4.00	NPS
1/1/95	9	Stakeholder Management and Mapping the Health Care	8.00	8.00	NPS
9/19/95	9A	Stakeholder Management and Mapping the Health Care	3.00	3.00	NPS
12/31/95	13	Total Quality Leadership - The Application	8.00	8.00	NPS
1/1/95	18	Effective Information Systems	4.00	4.00	NPS

Figure I-4. Class Subform

D. ADDING A CLASS


Using the “**Add New Class**” form is the only way to add a new class occurrence to an officer’s record. Clicking on the **Add Class** button opens the “**Add New Class**” form (Figure I-5).


Figure I-5. Add New Class Form

To add a new class, click on the “Add” button  and all of the form’s data fields will clear. Click on the SSN field, type the officer’s SSN, and press enter. The officer’s name will automatically appear next to the **Name:** label if the SSN has been entered correctly. The user jumps to the next field by pressing enter after typing in the information.

The course text box uses a “pick” list which, when selected, shows all of the EME course modules. Course modules may be entered by selecting the appropriate entry from the “pick” list or by typing the number in the text box.

For multiple class entries, such as from a course completion roster, the user can easily enter information on many officers right from the same “Add a Class” form. The user simply enters a new SSN and course number and then double clicks in the other fields on the form to paste the previously entered information in the appropriate text box. This method significantly speeds up class roster data entry.

To delete an incorrect entry use the “Delete” button  and re-enter the correct information.

The “Close” button  returns the user to the Officer Record form.

E. SYSTEM TABLES

Clicking the **Tables** button on the Officer Record form opens the Table Switchboard (Figure I-6).

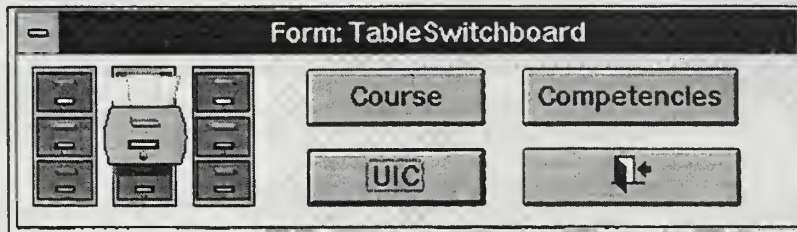


Figure I-6. Table Switchboard

Selecting any of the three buttons (Course, Competencies, or UIC) opens the appropriate database table. Information in each the database table (Figure I-7) may be added, modified or deleted subject to the application database integrity rules.

Table: COURSE					
	Course ID	Course Name	Hours	CEU Cre	Course Sponsor
▶	1	Understanding and Effectively Using Comm	4.00	4.00	NPS
	2	Communication Vision and Change in a Cor	4.00	4.00	NPS
	3	Empowering Associates Through Strategic	4.00	4.00	NPS
	4	Bottom-Line and High Impact Health Care C	8.00	8.00	NPS
	5	Listening for Success	4.00	4.00	NPS
	6	Meeting Management	4.00	4.00	NPS

Figure I-7. Database Table

The “Close” button takes the user back to Officer Record form.

F. SYSTEM REPORTS

EMETRAK has ten pre-formatted reports. To access EMETRAK system reports, the user selects the “**Reports**” button on the Officer Record form. This event opens the “**Select a Run**” switchboard menu (Figure I-8).

Select a Run	
All Officers in Alphabetical Order	1
Officers Grouped by Command	2
List of All Modules (with descriptions)	3
Classes Given in the Last 90 Days	4
Modules Completed by a Specific Officer	5
List of All Modules by Competency	6
Officers and Completed Modules Grouped by	7
Profiler	8

Buttons: Query, Print Preview, Print, Back Arrow

Figure I-8. Reports Switchboard

The “**Select a Run**” switchboard allows the user to select from one of the ten pre-formatted reports in either query view (tabular format), print preview mode or printed format.

Select the desired report by clicking on the report title and clicking on either of the three action buttons (query, print preview, or print). Some reports require a more refined selection criteria (e.g. specific SSN or name) and will prompt the user for more input. The user enters the desired criteria through the use of a dialog box similar to Figure I-9. Once the user provides the criteria and presses enter the report can either be viewed or printed depending on the selection.

Officer Name

Enter a Last Name, or
Press Enter for all Officers

Buttons: OK, Cancel

Figure I-9. Input Box

The “**Close**” button returns the user to the Officer Record form.

G. VIEWING OFFICER COMPETENCIES

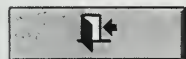
Selecting the **Competencies** button opens the officer’s Competency Count form (Figure I-10). The Competency Count form shows the number of hours that the officer has completed grouped by EME competency category.

Competency	How Many Courses	Total Hours
Group Dynamics	2	14
Managing Change & Tech Innovati	1	12

Figure I-10. Competency Count Form

Close the Competency Count form by double-clicking on the minus (-) sign in the upper left corner of the form.

H. CLOSING THE APPLICATION



Clicking on the “Exit” button on the Officer Record form closes the EMETRAK application. However, before the application completely closes down, the user is presented with a dialog box which asks if you desire to back up the database (Figure I-11).

Back Up or Exit

Would you like to back up the database?

Figure I-11. Exit Dialog Box

Selecting “Yes” on the **Back Up or Exit** dialog box starts the back up procedure. The back up procedure takes several minutes and requires that you insert 1.44 MB floppy disks in **drive a:** when prompted. After the the back up procedure is completed, select “OK” in the appropriate message box and the application will close normally. If “No” is selected in the **Back Up or Exit** dialog box, the EMETRAK program automatically closes out to the Windows desk top. The alternate method of closing the EMETRAK application is by selecting “Exit” from the “File” pull-down menu. This method by-passes the back up procedure.



APPENDIX J. MULTI-USER SYSTEM STATE TRANSITION DIAGRAMS

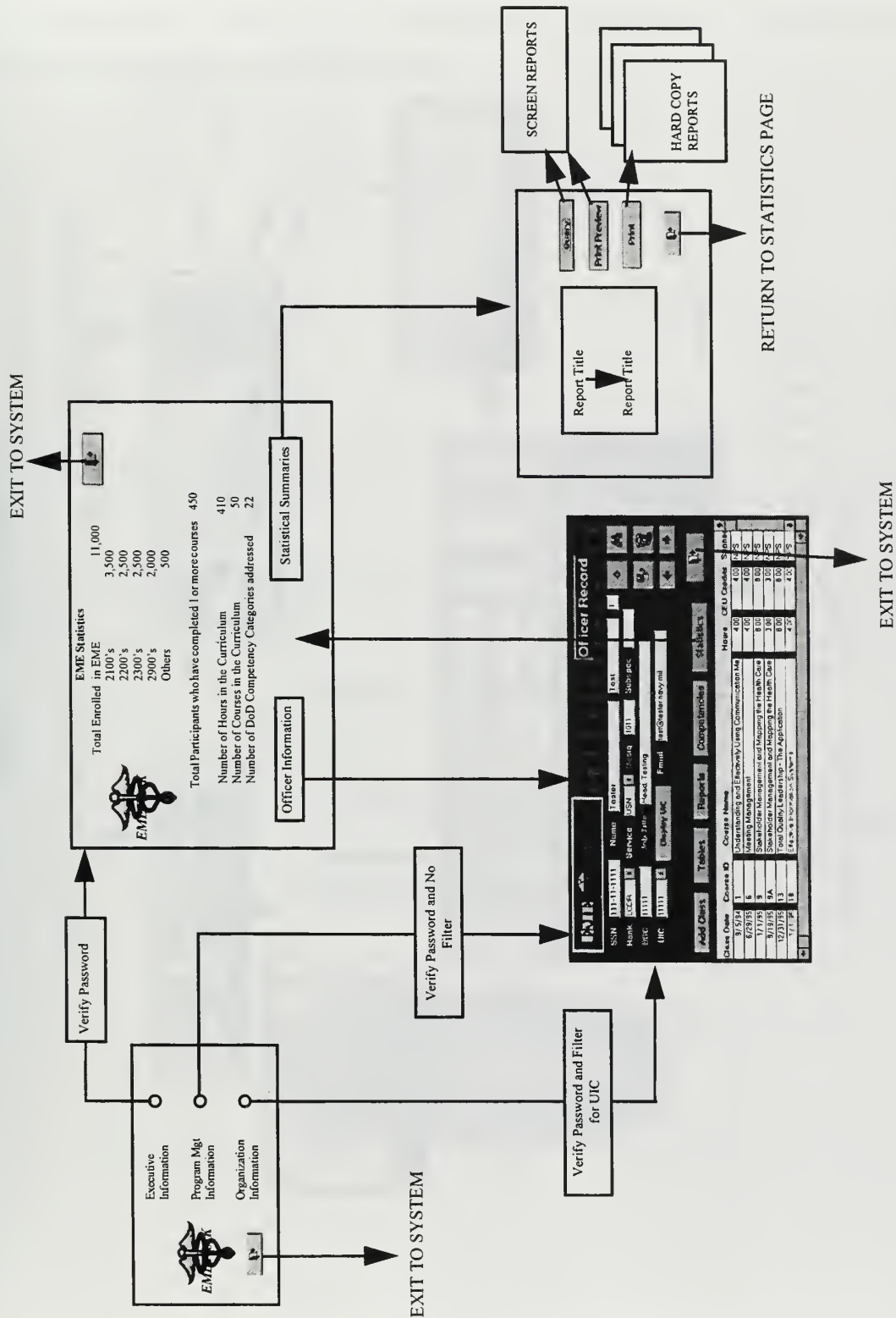


Figure J-1. Enterprise and Program Management Views

APPENDIX K. STATISTICAL REPORT FORMATS

This appendix provides sample formats for the different types of statistical presentations required in the EMETRAK multi-user system.

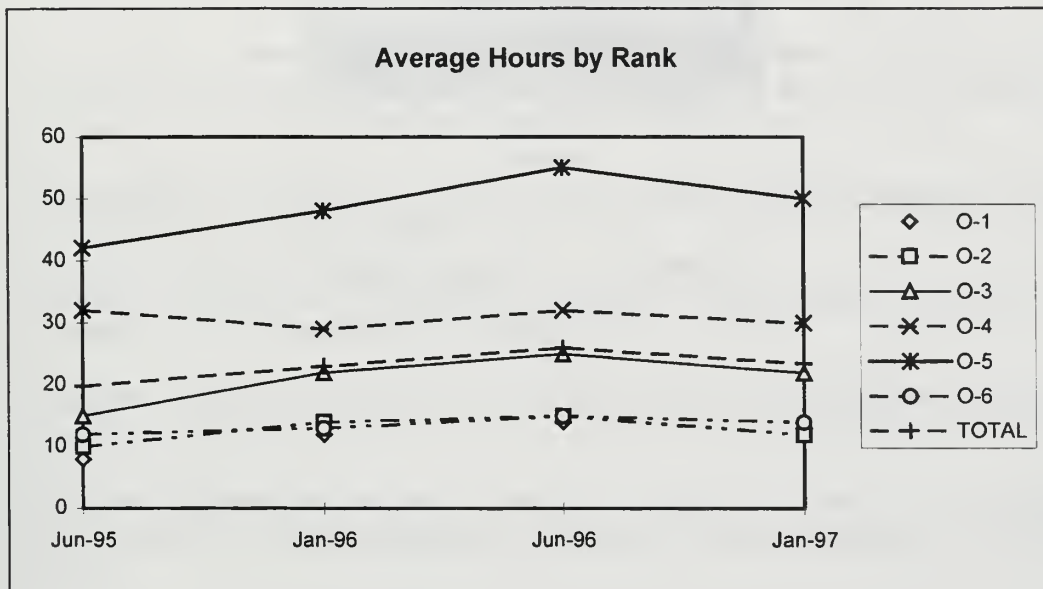


Figure K-1. Line Graph Format

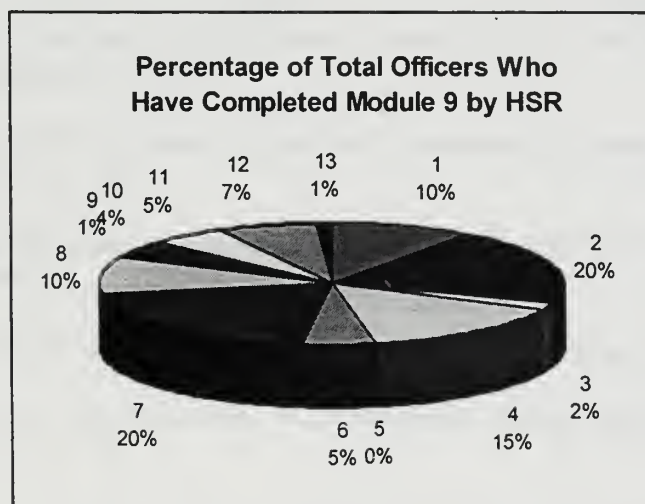


Figure K-2. Pie Chart Format Format

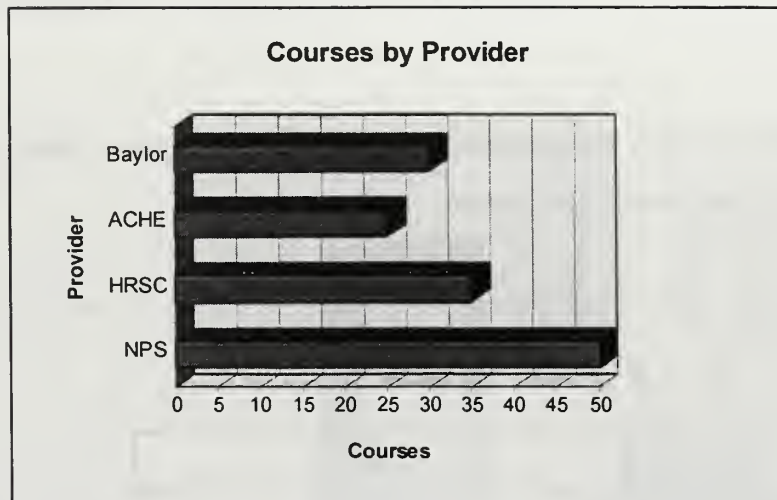


Figure K-3. Bar Graph Format

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